

AD-A065 002

AIR FORCE ACADEMY COLO

ANNUAL RESEARCH PROGRESS REPORT NUMBER 13, 1 JULY 1977-30 SEPT--ETC(U)

OCT 78

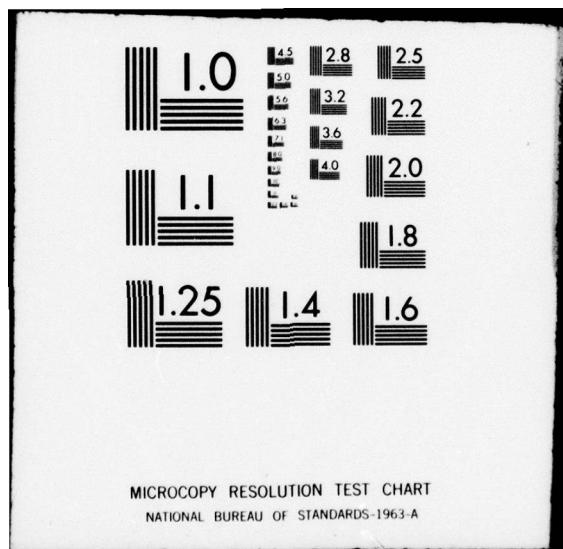
F/G 5/2

UNCLASSIFIED

NL

1 OF 2  
AD  
A065002





AD A 065 002

DDC FILE COPY

LEVEL II

6

Number

12

Annual Research Progress Report No. 13

[REDACTED]

1 July 1977 - 30 September 1978.

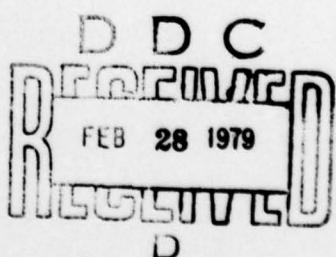
11 Oct 78

12 125p.

This document has been approved for public release and sale;  
its distribution is unlimited

This is the sixth published Annual Research Progress Report; the editions previous to 1972 were published as Semi-Annual Progress Reports. Further information desired on any project may be obtained by writing to the department listed for the principal investigator, USAF Academy, Colorado 80840.

SEARCHED	INDEXED
SERIALIZED	FILED
RECORDED	
JULY 1978	
DISTRIBUTION/AVAILABILITY CODES	
DISC	AVAIL 000/000000
A	



011550

LB

## TABLE OF CONTENTS

	Page
<b>I. SCIENTIFIC AND ENGINEERING INVESTIGATIONS</b>	
A. Department of Aeronautics	
1. Flow Field Disturbance Created by Porous Spoilers . . . . .	1
2. The Flow Dynamics of Unsteady Separating Regions . . . . .	1
3. Improved Airplane Maneuvering Performance . . . . .	2
4. Productive Applications of Dynamic Aeroelasticity . . . . .	2
5. Estimation of Instantaneous Distortion for the YF-12C Inlet . . . . .	3
6. Plume Effects on Missile Aerodynamics . . . . .	3
7. Laser Doppler Velocimeter Development for USAFA Wind Tunnels . . . . .	4
8. Academy Turbine Engine Test Facility . . . . .	4
9. Aircraft Protuberance Drag . . . . .	4
10. Pitot Static Systems . . . . .	5
B. Department of Astronautics and Computer Science	
1. Defining the Computer Science Curriculum . . . . .	5
2. Academic Test Generation System . . . . .	5
3. Special Education Data Base Management System . . . . .	6
4. System Enhancements to Provide Visual Demonstration of Algol Programs . . . . .	6
5. Data Base Development for Statistical Research . . . . .	6
6. USAF Academy Computer Graphics System Design . . . . .	7

7. Survey of Software Engineering Factors . . . . .	7
8. Burroughs TD820/HP7210A Interface . . . . .	8
9. USAF Academy Computer Graphics System Development . . . . .	8
10. GPSS Compiler Enhancements . . . . .	8
C. Department of Chemistry and Biological Sciences	
1. Pattern Analysis and Correlation of Weather and Air Pollution Data in the Pikes Peak Region . . . . .	9
2. Photochemical Energy Storage . . . . .	9
3. Ultrastructural Analysis of Mammalian Tissues Exposed to Depleted Uranium . . . . .	10
4. Reaction of Mesylate Esters with Energetic Alcohols . . . . .	10
5. A Spectroscopic Investigation of the Selenium Halides . . . . .	11
6. Determination of the Effects of Wastewater Reuse . . . . .	11
7. An Evaluation of Worldwide Endeavors in Genetic Engineering . . . . .	13
8. Fate of Herbicide Orange in Soils . . . . .	13
9. Analysis of TCDD in Biological Samples . . . . .	13
10. Chemical and Microbiological Monitoring of Sites Previously Used for Storage of Military Herbicides . . . . .	14
11. The Effect of Hyperbaric Oxygen on Mycotic Disease Agents . . . . .	15
12. Chemical Structure/Bonding Decomposition Relationships . . . . .	15
13. Citizen's Workshop Program on Energy and the Environment . . . . .	16
14. Comparison of Stress Responses in Male and Female Cadets at the USAF Academy . . . . .	17
15. Physical and Electrochemical Measurements . . . . .	18
16. Chemiluminescent Gas Phase Reactions . . . . .	19

D. Department of Civil Engineering, Engineering Mechanics and Materials	
1. Bio-Engineering . . . . .	19
2. Certification of Side Facing Troop Seats for the UV-18 Aircraft . . . . .	20
3. Development of General Second Order Component Mode Synthesis With Application to Rotor Bearing Systems . . . . .	20
4. Dynamics of Aircraft-Runway Interaction . . . . .	20
5. Elastic Waves in Layered Media . . . . .	21
6. Finite Element Cable Studies . . . . .	21
7. Fracture Mechanics . . . . .	22
8. High Speed Ground Transportation . . . . .	22
9. Hot Corrosion . . . . .	23
10. Load Deformation Relationship for Split-Ring Timber Connectors.	23
11. Metal Joining Techniques . . . . .	23
12. Solar Energy . . . . .	24
13. Tension-Torsion Interaction Strength of Laminated Wood Bolts .	25
14. T-38 Structural Integrity . . . . .	25
15. Turbine Engine Metal Matrix Composite Blade Analysis . . . . .	25
16. Wind Energy Conversion System (WECS) . . . . .	26
E. Department of Electrical Engineering	
1. Space Test Program Experiment Prioritization . . . . .	26
2. Microprocessor System Development for Aircraft Simulation Visual System Control . . . . .	26
3. Portable, Self-Contained, Educational Microprocessor System Development . . . . .	27

4. Microprocessor Instrumentation of the F-15 APG-63 Radar . . . . .	27
5. Data Acquisition System Development . . . . .	28
6. Bulk Properties of Annealed High Resistivity Gallium Arsenide . . . . .	28
7. 6502 Microprocessor Emulator System . . . . .	28
8. Space Experiment Integration . . . . .	29
9. Educomm - An Analog Communications Trainer . . . . .	29
10. Microcomputer Controlled Event/Alarm Scanner . . . . .	29
11. Measurement of Surface Change and Currents Utilizing Infrared Technology . . . . .	30

F. Department of Mathematical Sciences

1. Transhipment/Allocation Algorithm for Cadet Summer Transportation Requirements . . . . .	31
2. Safe Escape . . . . .	31
3. Digital Signal Sorting . . . . .	32
4. Development of a Fix Computation Algorithm for Use in High-Frequency Direction-Finding Systems . . . . .	32
5. Mathematical Modeling and Identification . . . . .	33
6. Network Evaluation Through Simulation . . . . .	33
7. USAFA/DMA R&D Program . . . . .	33
8. Shock Waves in Explosives . . . . .	34
9. An Encke Method in Poincare'-Similar Elements . . . . .	34

G. Department of Physics

1. A Study of Proton Range "Straggling" Due to Initial Beam Energy Distribution . . . . .	35
---	----

2. Determination of 14 MeV Neutron Fluences Using Copper Activation Foils and Gamma Coincidence Counting . . . . .	35
3. Soft X-Ray Emission from Coronal Loops . . . . .	36
4. Chemical Structure/Bonding Decomposition Relationships and Chemiluminescent Gas Phase Relationships . . . . .	36
5. Laser Isotope Separation - Economics and Applications . . . . .	37
6. Aircraft Engine Oil Analysis by Neutron Activation Techniques. . . . .	38
7. Diurnal Variation of Total Electron Content of the Ionosphere. . . . .	38
8. Optical Detection of Damage in Solids . . . . .	38
9. Analysis of Photometric Data on the Massive Eclipsing Binary Star V382 Cygni . . . . .	39
10. Design and Fabrication of a Current-Technology Flywheel-Electric Vehicle . . . . .	40
11. A Physics Model of a Runner for Possible Use in Athlete Training and Education at the United States Air Force Academy. . . . .	40

## II. GENERAL RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES

### A. Department of Behavioral Sciences and Leadership

1. Pilot Performance with Peripheral Vision . . . . .	41
2. The Effects of Job Enrichment and Goal Setting on Job Satisfaction and Organizational Effectiveness . . . . .	41
3. Stress Management Research . . . . .	42
4. Male and Female Anxiety During Survival, Evasion, Resistance and Escape (SERE) Training . . . . .	42
5. Reacquisition and Maintenance of Flying Skills . . . . .	43
6. Personal and Environmental Factors Contributing to BCT and Fourth Class Year Attrition . . . . .	43
7. Similarities of Men and Women in Perceptions of Their Work and Their Affective Responses: An Empirical Test . . . . .	44

8. Analysis of Soviet Behavioral Sciences . . . . .	44
9. Analysis of Information Sources Within the Air Force . . . . .	44
B. Department of Economics, Geography and Management	
1. Preferential Tariff Reductions: The Philippine Response, 1900-1940 . . . . .	46
2. The Rent-Buy Decision for Military Families . . . . .	46
3. The Utilization of Side-Looking Airborne Radar (SLAR) in the Analysis of Karst Topography . . . . .	47
4. Change After an Earthquake Disaster in Western Anatolia . . . . .	47
5. Analysis of Crime in Manitou Springs, Colorado (1976-June 1977) . . . . .	48
6. Energy Atlas of Montana . . . . .	48
7. Energy Atlas of Utah . . . . .	49
8. Energy Atlas of Wyoming . . . . .	49
9. Energy Atlas of Colorado . . . . .	49
10. Climate, Soils and Vegetation of the Rampart Range, Colorado . . . . .	50
11. Natural and Man-Induced Soil Pollution . . . . .	50
12. Future Patient Demand in the USAF Academy, Colorado Hospital Catchment Area . . . . .	50
13. Avalanche and Non-Avalanche Talus Slope Comparison Colorado Front Range . . . . .	51
14. Preparation of Maps for Use by the FEA . . . . .	51
15. Predicting Casualties and Damages Caused by Earthquakes in Turkey . . . . .	51
16. A Model for Public Education on Earthquake Hazard Minimization . . . . .	52
17. Perspectives on Turkey . . . . .	52

18. Construction in Seismic Zones: A Model for Users and Planners . . . . .	53
19. Seven Years After Disaster: Old and New Gediz in Light of Kates' and Pijawka's Model . . . . .	53
20. Decision Making and Natural Disasters . . . . .	53
21. Harmonic Analysis of Precipitation in Turkey . . . . .	53
22. Hello, Is Anyone Out There? . . . . .	54
23. Performance Appraisal, Assertiveness Training, Personal Awareness, Management Styles . . . . .	54
24. Management by Objectives . . . . .	54
25. Preparing a Budget for Equal Opportunity Programs . . . . .	54
26. Communication and Motivation: Your Most Important Tools . . . . .	54
27. Time Management . . . . .	55
28. The USAFA Management Curriculum . . . . .	55
29. Communication Workshop . . . . .	55
30. You, Your Job, and Your Future . . . . .	55
31. Sergeants Administrative Workshop . . . . .	55
32. Giants in Management: Jim Webb of NASA . . . . .	56
33. Organization Climate . . . . .	56
34. First-Line Management--Police Sergeant's Administrative Workshop . . . . .	56
35. How Am I Doing, Boss? . . . . .	56
36. The USAFA Management Curriculum . . . . .	56
37. Collaborative Goal Setting in Performance Appraisal: A Field Experiment . . . . .	57

C. Department of English

1. Glossary of Poetic Terms . . . . .	57
2. The Good Old Days?: Joel Chandler Harris and Charles W. Chesnutt . . . . .	57
3. John Burgoyne's "Lord of the Manor" and the Beginnings of English Musical Comedy . . . . .	58
4. Cleanth Brooks at USAFA . . . . .	58
5. "Brother to Dragons": A Discussion . . . . .	58
6. Flannery O'Connor: A Companion . . . . .	59
7. Wild Bill Shakespeare Rides Again . . . . .	59
8. Orphans of the Storm: Running a College-Level Theatre Program Withoug a Theatre Major or Theatre Department . . . . .	59
9. The Paperwork Air Force: Adapting Air Force Writing to Air Force Needs . . . . .	60
10. Human Nature and Four Humorists of the Old Southwest: Hooper Lewis, Warren, and Harris . . . . .	60
11. Henry Clay Lewis (a biographical entry) . . . . .	60
12. Black Literature and the Military Mind . . . . .	61
13. Air Force Effective Writing Course . . . . .	61
14. The Air Mail Emergency of 1934: The Heisenberg Principle Exemplified in Journalism . . . . .	61
15. The Introduction of Televised Instructional Material into the USAF Air Command & Staff College Non-Resident Curriculum: An Experimental Comparison with Existing Methods . . . . .	62
16. Book Review of "Scott of the Antarctic" by Elspeth Huxley . . . . .	62
17. Donne and the Herbert Family . . . . .	63
18. Come Down Out of Your Ivory Tower, Professor: The English Department and the World Outside . . . . .	63

19. Herman Melville and the Art of Leadership . . . . .	63
20. Technical Writing and Television . . . . .	64
21. Competitive Speechmaking . . . . .	64
D. Department of Foreign Languages	
1. The Cloze Test as a Procedure for Establishing Objective German Prose Readability Standards . . . . .	64
2. Computer Management of Foreign Language Grading and Test Analysis at the Air Force Academy . . . . .	65
3. Study Packets to Accompany the Soviet Language Text, Russian for Everybody . . . . .	65
4. Soviet Thoughts on Military Leadership . . . . .	65
E. Department of History	
1. A History of the United States Air Force . . . . .	66
2. USAFA Oral History Program . . . . .	66
3. The Harmon Memorial Lectures in Military History . . . . .	67
4. Chinese Perspectives in Selected Western Literature, 1915-1930 . . . . .	67
5. Yeoman Regions in the Antebellum Deep South: Settlement and Economy in Northern Alabama, 1815-1860 . . . . .	67
6. American Military Missions to Korea: 1882-1896 . . . . .	67
7. Korean Immigration to the United States . . . . .	68
8. American Forces in Foreign Cultures . . . . .	68
9. Air Force Atomic Capability from V-J Day to the Berlin Blockade--Potential or Real? . . . . .	69
10. Strategic Thought to 1945 . . . . .	69
11. U.S. Foreign Policy and Diplomacy . . . . .	69

12. International Politics and Strategy . . . . .	69
13. The Periodical Press and the London Naval Conference . . . . .	70
14. The American Military Establishment and the Creation of a Postwar Overseas Military Base Network, 1942-1948 . . . . .	70
15. Modern Warfare and Society . . . . .	70
16. Timothy Walker and the Growth of American Law . . . . .	71
17. Family Structure in a Colonial New England Town . . . . .	71
18. The Role of the Colorado National Guard in Civil Disturbances .	71
19. General Hoyt S. Vandenberg, Sr. . . . .	71
20. The Creation of the GHQ Air Force . . . . .	72
21. General Benjamin Foulois and His Air Corps . . . . .	72
22. The 1934 Air Mail Fiasco . . . . .	72
23. The Military Profession in America . . . . .	73
24. The Air Corps-Navy Struggle over the Coast Defense Mission, 1920-1941 . . . . .	73
25. The Career of the Reichswehr Officer . . . . .	73
F. Department of Law	
1. Personal Estate Planning . . . . .	74
2. Copyright in Works Prepared Using Government Resources . . . .	74
3. The Vagueness Doctrine and Cadet Disenrollment for Other Misconduct under AFR 53-3 . . . . .	74
4. Disclosure of United States Air Force Academy Library Patron Records to Law Enforcement Agencies . . . . .	74
5. Public Access to Oral History Interview Tapes and Transcripts .	75
6. Publication of Article Prepared for Classroom Use at USAFA . .	75

G. Department of Mathematical Sciences	
1. Math Achievement Test Analysis . . . . .	75
2. Core Math Data Base . . . . .	76
3. An Individualized Mastery System of Instruction in Core Mathematics . . . . .	76
4. Cost Containment in Military Medical Care . . . . .	77
H. Department of Philosophy and Fine Arts	
1. On the Nature of Man . . . . .	77
2. Managerial Integrity . . . . .	78
3. Professionalism in Military and Federal Service . . . . .	78
4. Ethics and Institutions . . . . .	78
5. Become the Ethical Dream . . . . .	78
6. Christian Morality and the Cadet Honor Code . . . . .	79
7. Ethics and the Military Profession; War and Morality . . . . .	79
8. Whatever Happened to Sin . . . . .	80
9. Lanka: A Visual Diary . . . . .	80
10. Managerial Ethics . . . . .	80
11. Practicum in Ethics . . . . .	81
12. Professional Ethics . . . . .	81
13. War, Morality, and the Military Profession . . . . .	81
I. Department of Political Science	
1. American Defense Policy . . . . .	82
2. Counterinsurgency: The Thai Case . . . . .	82
3. The Politics of East Asia . . . . .	83

4. The Political Element in Professional Military Expertise . . . . .	83
5. The Ideology of Preparedness . . . . .	83
6. Defense Decision-making in the Organizational Bureaucratic Context . . . . .	84
7. Public Administration and the Military . . . . .	84
8. In Case of Deluge: Where Nuclear Proliferation Meets Conventional Arms Sales . . . . .	84
9. How Military Elite Role Perceptions in Southeast Asia Conflict with the Civil-Military Paradigm . . . . .	85
10. Trends in Constitutional Development . . . . .	85
11. Legislative Liaison in DOD . . . . .	85
12. The National Security Council System . . . . .	86
13. Analyzing Chinese Factions . . . . .	86
14. Understanding China . . . . .	86
15. Panama Canal Treaties . . . . .	87
16. Congressional Elections: Incumbency and Service to Constituents . . . . .	87
17. President Carter's Foreign Policy . . . . .	87
18. Military Roles in Southeast Asia . . . . .	87
19. The Central Mystery of Political Science and the Study Canadian Defense Policy--Is It Time For a New Approach? . . . . .	88
20. Hot Spots in Today's World . . . . .	88
21. POW Experiences . . . . .	88
22. NATO Defense Planning . . . . .	88
23. Presidential Memorandum #10 . . . . .	89
24. President Carter's Foreign Policy . . . . .	89

25. The Other Wiseman . . . . .	89
26. Ethical Considerations of Nuclear War . . . . .	90
27. The Role of the Military in Arms Limitation . . . . .	90
28. NATO's Long Term Defense Plan . . . . .	90
29. Strategic Balance and Arms Control Talks . . . . .	90
30. Political Analysis of Soviet Intentions . . . . .	91
31. Elements of Soviet Power - Strengths and Weaknesses . . . . .	91
32. Dilemmas of World Energy . . . . .	91
33. The Politics of Energy . . . . .	92
34. NATO Strategy . . . . .	92
35. The President's Commission on Military Compensation Proposals: A Legislative Strategy . . . . .	92
36. The Evaluation of the U.S.-Canadian Defense Economic Relationship and Its Applicability to NATO Standardization .	92
37. NATO and Oil: Conflict and Capabilities . . . . .	93
38. Justifying the MX . . . . .	93
39. Independent Review and Assessment of Space and Missile Systems Organization Test and Evaluation Architecture . . . . .	93
40. Recent Trends in Administration and Congressional Attitudes Impacting on Reentry Technology . . . . .	94

### III. RESEARCH AND ANALYSIS OF SPACE AND WEAPONS SYSTEMS

#### A. Department of Astronautics and Computer Science

1. Research Support for the NACSTAR Global Positioning System (GPS) . . . . .	95
a. GPS Magnetic Momentum Dumping Control Program . . . . .	95

b. GPS Constellation Studies . . . . .	96
c. GPS User Navigation During the Limited Operational Capability Phase (Phase II) . . . . .	96
2. Air to Air Fire Control Research . . . . .	97
3. Independent Review and Assessment of SAMSO Test and Evaluation Architecture . . . . .	97
4. Automation of the AF Form 1537 . . . . .	98
5. Software Development for Drones . . . . .	99
6. Economic Price Adjustment Model . . . . .	99
7. Data Compression and Display Techniques . . . . .	99
B. Department of History	
The X-15's Role in Aerospace Progress . . . . .	100
IV. MANPOWER, PROCUREMENT AND LOGISTICS STUDIES	
A. Department of Economics, Geography and Management	
1. A General Technique for R&D Cost Forecasting . . . . .	101
2. Management Science Applications in the Arena of the Operational Air Force . . . . .	101
3. A General Model for R&D Cost Forecasting . . . . .	101
4. Forecasting Air Force Expenditures in the 3600 Category .	101
5. Observable Preference for Public Goods . . . . .	102
6. Nursing Cost Prediction for Budgeting and Control . . .	102
7. The Evaluation and Utilization of Tanker Cargo Aircraft .	102
8. Replacement Cost Accounting: Its Possible Effects on Government Contracts . . . . .	103
9. Review of the Application of the O&S Cost Model to the A-10 Program Contractor Incentive Award Fee . . . . .	103

10. Follow-up Recommendations Presented in A-10 O&S Model Review . . . . .	104
11. Forecasting Retail Sales in AAFES, Conus at Headquarters Army and Air Force Exchange Service . . . . .	104
12. A Model for Management of USAFA Cadet Uniform Inventory . .	104
13. Performance Incentives and Planning Under Uncertainty . .	104
14. Optimal Subsidy Functions . . . . .	105
15. Strategic Stockpiling and Substitution . . . . .	105
16. Technical Communication in Research and Development: A Longitudinal Analysis . . . . .	106
17. A Model for MBO in the Air Force . . . . .	106
B. Department of Mathematical Sciences	
1. Aircraft Modification Study . . . . .	107
2. Statistical Analysis of Demand and Leadtime Data for the Air Force Standard Base Supply System . . . . .	107

## I. SCIENTIFIC AND ENGINEERING INVESTIGATIONS

### A. Department of Aeronautics

#### 1. Flow Field Disturbance Created by Porous Spoilers

Principal Investigator: Lt Colonel Richard F. Felton, Department of Aeronautics

Associate Investigators: Captain Michael M. Tower, Department of Aeronautics; Cadet Stephen G. Wurst, Class of 1977; Cadet James W. Foister III, Class of 1977

Sponsored by the Air Force Weapons Laboratory, Air Force Systems Command (AFSC)

An experimental investigation of the flow field in a cavity located downstream from a porous spoiler is being conducted in the Department of Aeronautics trisonic wind tunnel. Initial tests on flat plate models have been concluded and the present work is associated with a cavity located in a cylindrical model. Various configurations of porous spoilers have been investigated. Results indicate that a comb type spoiler ("snow fence") yields the minimum perturbation on the surface of the model. Future plans are to investigate the pressure variation in the cavity.

#### 2. The Flow Dynamics of Unsteady Separating Regions

Principal Investigators: Major James D. Lang, Department of Aeronautics; Captain Michael S. Francis, Captain John E. Keesee, Frank J. Seiler Research Laboratory (AFSC)

Associate Investigators: Captain John P. Retelle, Jr., Air Force Institute of Technology, University of Colorado; Cadet Neil A. Youtsler, Class of 1977; Cadet John J. Albert, Cadet Davis L. Kluczinske, Class of 1978

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

The unsteady separating flowfield produced by an oscillating fence-type spoiler on an airfoil is being investigated. Surface pressures as well as flowfield velocities, circulation and the vorticity field are measured experimentally. Knowledge of the flow physics is the goal of this study, and during this period measurements were compared to predictions of an analytical model.

### Publications

"Interaction of an Oscillating Control Surface with an Unsteady Separated Region," Journal of Aircraft, Vol. 13, No. 9, September 1976, pp. 687-694.

"Dynamic Loading on an Airfoil Due to a Growing Separated Region," Prediction of Aerodynamic Loading, AGARD Conference Proceedings No. 204, September 1976, pp. 26-1 - 26-12.

### Presentations

"Dynamic Loading on an Airfoil Due to a Growing Separated Region," AGARD Symposium on Prediction of Aerodynamic Loading, NASA Ames, 29 Sept 1976.

"Dynamic Effects of a Growing Separated Region on an Airfoil," Univ. of Tenn. Space Inst. short course on Flow Separation, 19 April 1977.

#### 3. Improved Airplane Maneuvering Performance

Principal Investigators: Major James D. Lang, Department of Aeronautics; Captain Michael S. Francis, Captain John E. Keesee, Frank J. Seiler Research Laboratory (AFSC)

Sponsored by the Frank J. Seiler Research Laboratory and the AF Flight Dynamics Laboratory, Air Force Systems Command (AFSC)

Improved airplane turn performance was first investigated by calculating turn trajectories for a high performance lightweight fighter when the dynamic stall phenomenon is employed. Improvement to performance depends on the degree to which lift can be sustained at low airspeeds. Further study is devoted towards the practical application of dynamic stall and sustained lift in maneuvering flight.

### Presentations

"Good, Better and Best Turn Performance," AF Flight Dynamics Laboratory, 11 March 1977.

#### 4. Productive Applications of Dynamic Aeroelasticity

Principal Investigator: Captain Stephen M. Batill, Department of Aeronautics

Sponsored by the Air Force Flight Dynamics Laboratory, Air Force Systems Command (AFSC)

Dynamic aeroelastic characteristics, such as flutter and aileron buzz, have been considered adverse phenomena. This project has been established to investigate possible beneficial effects associated with unsteady aerodynamics in the areas of energy required for flight and flight performance. Analytic and experimental studies are planned to investigate the unsteady aerodynamic cycles.

5. Estimation of Instantaneous Distortion for the YF-12C Inlet

Principal Investigator: Captain Howard M. Brilliant, Department of Aeronautics

Associate Investigator: Carol Bauer, NASA Dryden Flight Research Center (DFRC)

Sponsored by NASA Dryden Flight Research Center

A method of predicting expected maximum instantaneous distortion was applied to the inlet of NASA's YF-12C airplane. The predictions have been compared to flight test data with good correlation. The current effort involves comparing wind tunnel data and flight test data to see if wind tunnel data can be used to predict flight performance.

Publications

"Comparison of Estimated with Measured Maximum Instantaneous Distortion Using Flight Data From an Axisymmetric Mixed Compression Inlet," to be presented at the AIAA/SAE 13th Joint Propulsion Meeting, July 11-13, 1977.

6. Plume Effects on Missile Aerodynamics

Principal Investigator: Captain Howard M. Brilliant, Department of Aeronautics

Associate Investigator: Captain Randall J. Stiles, Department of Aeronautics

Sponsored by the Army Missile Command, Huntsville, Alabama

Exhaust gases of rocket propulsion systems can have delirious effects on the aerodynamic control of missiles by causing separation of the flow field ahead of control surfaces. The purpose of this work is to experimentally evaluate the effects of this phenomena and to find means of avoiding the problem.

## 7. Laser Doppler Velocimeter Development for USAFA Wind Tunnels

Principal Investigators: Captain George Sparks, Captain John Retelle, Department of Aeronautics; Captain Michael Francis, Captain John Keesee, Frank J. Seiler Research Laboratory

Sponsored by Frank J. Seiler Research Laboratory and Air Force Flight Dynamics Laboratory, Air Force Systems Command (AFSC)

A computer position controller laser doppler velocimeter was designed and built for use in the Academy's wind tunnels. Although needed specifically for unsteady flow research data collection, the system can be used in any of the wind tunnels. An operational check of the system has been completed and data collection is expected to start in Dec 1978.

### Publications

Related Publications - (1) "A Laser Doppler Velocimeter for the USAFA Subsonic and Trisonic Wind Tunnels - A Feasibility Study," George W. Sparks, Jr. and Michael S. Francis, Frank J. Seiler Research Laboratory, SRL-TM-2307-77-1, October 1977; (2) "The Development of a Laser Doppler Velocimetry System for Unsteady, Separated Flow Research - Preliminary Results," R. A. Kadlec, G. W. Sparks, Jr., M. S. Francis, Frank J. Seiler Research Laboratory, FJSRL-TR-78-1, October 1978.

## 8. Academy Turbine Engine Test Facility

Principal Investigators: Captain Howard M. Brilliant, 2nd Lt D. Neal Barlow, Department of Aeronautics; Dr. G. David Huffman, Purdue University

Sponsored by the Air Force Propulsion Laboratory, Air Force Systems Command (AFSC).

The goal of this project is to develop an Academy facility to support the exploratory development objectives of the Propulsion Laboratory. It presently appears that a component test facility, probably a compressor and/or a turbine cascade wind tunnel will be built. After a decision as to direction a preliminary design and cost analysis will be completed. Facility completion date would be late FY 80 or FY 81.

## 9. Aircraft Protuberance Drag

Principal Investigators: Major Steven E. Icardi, Captain Eric J. Jumper; Department of Aeronautics

Sponsored by the Air Force Weapons Laboratory, Air Force Systems Command (AFSC)

The flow fields around various laser firing turrets are being investigated to determine the configuration producing minimum aircraft drag. After completion of this study the optimum turret configuration for a variety of air speeds and aircraft locations will be predicted.

#### 10. Pitot Static Systems

Principal Investigators: Lt Colonel William A. Edgington, Captain William Dieterich; Department of Aeronautics

Sponsored by the Air Force Armament Test Laboratory, Air Force Systems Command (AFSC)

Data was collected on various pitot static system characteristics to produce a users handbook. The book would list the various system types, advantages and disadvantages greatly simplifying the designer's workload.

### B. Department of Astronautics and Computer Science

#### 1. Defining the Computer Science Curriculum

Principal Investigator: Lt Colonel John A. Zingg, Department of Astronautics and Computer Science

Associate Investigators: Lt Colonels Donald G. Pursley and Jerry B. Smith; Majors Larry E. Druffel, Kenneth L. Krause, Vance A. Mall, Joseph Monroe, and Captain Robert J. Kirkpatrick, Department of Astronautics and Computer Science

In examining the field of computer science, the fundamental principle which emerges is that computers and computer scientists exist to solve problems. Using the computer for problem solving creates two basic types of problems. The first relates to the creation of computing power which involves the specification, acquisition and development of a computer environment. The second is concerned with the application of computing power to specific problems which normally includes an algorithmic software development. Computer problem solving which is composed of computing power creation and algorithmic software development then becomes the central theme or unifying concept which pervades computer science curriculum development.

#### 2. Academic Test Generation System

Principal Investigators: Majors Lawrence E. Druffel and Kenneth L. Krause; and Captain Julian W. Cole, Department of Astronautics and Computer Science

Associate Investigator: CIC James M. Johnson

This was Cadet Johnson's Computer Science 499 project, and was a continuation of a Computer Science 495 term project from the Spring Semester 1977. The earlier project involved the design of a system to generate academic tests from a data base of test questions written by a user. The system is composed of five modules. This project is the design of the module which accomplishes the actual generation of the desired tests. The design has been completed, but the implementation of the test generation module is not yet complete.

### 3. Special Education Data Base Management System

Principal Investigators: Lt Colonel John A. Zingg, Major Joseph Monroe, and Captain Julian W. Cole, Department of Astronautics and Computer Science

Associate Investigator: C1C Thomas D. Bell

This was a Computer Science 499 project for Cadet Bell. The Data Base Management System meets the needs of Colorado School District 20 for a system which is capable of maintaining the special education records of the district schools. The computer program which controls the data base operates in three phases: key-directory initialization, command file updates to the data base, and a disk write to save the updated data files. A user's manual is included to describe the purpose of each of the 29 commands as well as to describe the formats the user would use in order to execute properly each command in the command file.

### 4. System Enhancements to Provide Visual Demonstration of Algol Programs

Principal Investigators: Majors Lawrence E. Druffel and Kenneth L. Krause, Department of Astronautics and Computer Science

Associate Investigator: C1C Russell B. Kline

This was a Computer Science 499 project for Cadet Kline. This paper describes a system which provides a visual demonstration of the structure and flow of an ALGOL program. The system displays the program on a CRT terminal and executes it, highlighting each statement prior to execution and showing the result of the statement after execution. The primary use of the system is to demonstrate program operation in a classroom environment. It can also be used as an automatic bench-checking aid. Scrolling, table look-up, and human engineering are enhancements to the original system.

### 5. Data Base Development for Statistical Research

Principal Investigators: Lt Colonel George H. Walther and Captain Julian W. Cole, Department of Astronautics and Computer Science, and Major John Fer, Executive for Honor and Ethics

Associate Investigator: CIC Steven F. Ouellet

This was a Computer Science 499 project for Cadet Ouellet. This report presents the results of research into the design and development of a data base to provide an on-line capability for Honor Committee activity statistics at the United States Air Force Academy. The need for an on-line inquiry capability was demonstrated in the past year when it was not possible to answer quickly many of the questions related to the Honor Committee. The inquiry system used in the project was the Burroughs DMS II which includes the use of the Data and Structure Definition Language (DASDL), a Cobol interface program and the DMS II inquiry commands. Recommendations for future study include preparing all of the data for implementation when approval is granted.

#### 6. USAF Academy Computer Graphics System Design

Principal Investigators: Captains Robert J. Kirkpatrick and Robert H. Toews, Department of Astronautics and Computer Science

Associate Investigator: CIC Douglas L. Schrag

This was a Computer Science 499 project for Cadet Schrag. This report is in the form of a manual which describes the overall design of the GT40 Graphics Programming System developed at the United States Air Force Academy. The system allows programmers to program sophisticated graphic applications easily on the Digital Equipment Corporation's GT40 Graphics Display Terminal. Included in the manual are detailed descriptions of all system components and functions, as well as operating instructions written at the user/programmer level.

#### 7. Survey of Software Engineering Factors

Principal Investigators: Lt Colonel Donald G. Pursley, Major Lawrence E. Druffel and Captain William E. Ayen, Department of Astronautics and Computer Science

Associate Investigator: CIC Jon M. Davis

This was a Computer Science 499 project for Cadet Davis. This paper reports the finding of a study conducted to survey the problem and contributes something to its solution. The paper itself is an application of some design techniques uncovered by the study. The lifecycle for software development used in this paper is made up of twelve stages: management, definition, analysis, estimation, requirements, design, coding, documentation, testing, integration, acceptance, and maintenance. Each is treated in its own section which contains a description, a list of variables, and their possible impacts. Three variables were selected for further study. They are team organization, initial design, and documentation. The recommendations of the paper are to

use the paper itself as a tool for other studies in the software development area and to use the method of study used in this study. That method is to survey the whole area for a general background knowledge, and then select a specific area for an in-depth study or research.

8. Burroughs TD820/HP7210A Interface

Principal Investigators: Captains Paul K. Karger and Robert H. Toews, Department of Astronautics and Computer Science, and Captain David Dise, Department of Electrical Engineering

Associate Investigator: CIC Scott E. Ferguson

This was a Computer Science 499 project for Cadet Ferguson. This project involves designing, constructing, and implementing a system for interfacing a large main-frame computer to a small scale graphic plotter through a peripheral remote terminal device. Chosen to implement the interface system is a microprocessor, responsible for the control of the terminal and the plotter. The microprocessor, chosen for its power, speed, and flexibility, receives data from the remote terminal, interprets it as a series of plotting commands, and presents these commands to the plotter in its own format. Among the obstacles encountered in this project are: microprocessor systems design, assembly language firmware design, interface understanding, and high-level-language system software programming.

9. USAF Academy Computer Graphics System Development

Principal Investigators: Major Domonic P. Sorce, Captains Robert J. Kirkpatrick, Helen D. Knight, and Robert H. Toews, Department of Astronautics and Computer Science

Associate Investigator: CIC Douglas L. Schrag

This was a Computer Science 499 project for Cadet Schrag. This project involves the design, operation, and maintenance of the GT40 Graphics Programming System. This system augments the USAFA Graphics System by giving programmers easy access to the sophisticated graphics capabilities of the GT40 Graphics Display Terminal. These capabilities are provided by built-in graphics operations recognized by the PAL-11 cross-assembler and the GTALGOL cross-compiler of the USAFA Graphics System. These operations include automatic display-file management, positioning and drawing, subpicture definition, dynamic display modification, and interactive graphic input.

10. GPSS Compiler Enhancements

Principal Investigator: Lt Colonel Joseph Monroe, Department of Astronautics and Computer Science

This research resulted in the compaction and compression of the Burroughs 6700 GPSS compiler/translator. Run time of the system was increased by a factor of 4.

C. Department of Chemistry and Biological Sciences

1. Pattern Analysis and Correlation of Weather and Air Pollution Data in the Pikes Peak Region

Principal Investigator: Captain Elroy A. Flom, Department of Chemistry and Biological Sciences

Associate Investigators: Major C. R. Mitchell and Captain James Crowley, Department of Mathematics, 2Lt Stephen Thompson, Department Chemistry

Sponsored by Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

This project is a continuation of one initiated in 1977. The major effort has been to establish a three year data base of air pollutant and weather data in order to establish what correlations might exist between these parameters. The data base is nearing completion. Simple correlation as well as time series analyses have been applied to the data base. Initial studies show that air pollutant levels correlate well with the weather parameters of dew point and temperature. A spinoff project is the investigation of particulate level reduction by paving of roads in El Paso County. This project is still underway.

2. Photochemical Energy Storage

Principal Investigator: Captain Dennis J. Fife, Department of Chemistry and Biological Sciences

Associate Investigator: Captain Larry P. Davis, Frank J. Seiler Research Laboratory (AFSC)

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

The purpose of this study is to evaluate the kinetics and mechanism of sensitization of the photoisomerization of norbornadiene (NBD) to quadricyclane (Q) in order to effectively design new sensitizers offering improved characteristics. The isomerization of NBD to Q is a process utilizing a photochemical reaction to give a storable high energy product which may be controllably converted to starting material with a corresponding release of stored energy. Some preliminary experiments were done at Utah State while the principal investigator was on academic leave. Norbornadiene was photolyzed

at 313 nm using three different sensitizers. Cuporous chloride and acetophenone are known sensitizers. A tertiary phosphine complex was also used as a sensitizer with a quantum yield of approximately 0.80 calculated.

3. Ultrastructural Analysis of Mammalian Tissues Exposed to Depleted Uranium

Principal Investigator: Captain William D. Butler, Department of Chemistry and Biological Sciences

Sponsored by the Air Force Armaments Testing Laboratory, Air Force Systems Command (AFSC), Eglin AFB, Florida

Twenty Peromyscus polionotus (beach mice) were chronically exposed to low dosages of Triuranium Octaoxide ( $U_3O_8$ ) otherwise known as Depleted Uranium (Du), in the laboratory. Postmortem examination of control and test mice (exposed for 30, 37, 44, and 51 days to 500  $\mu\text{g}/\text{gm}$   $U_3O_8$  mixed with 0.2 gm Purina mouse chow, and given orally) revealed slight observable difference in spleen and adrenal gland sizes. The other internal organs and glands were quite uniform in size and shape. Initial X-ray microprobe analysis using the AMR 1000 Scanning Electron Microscope interfaced with the PGT 1000 digital computer indicated slight positive indications of tissue uptake of the heavy metal ( $U_3O_8$ ). Stereological analysis of liver photomicrographs will be completed by September 1979. Although tissue preparation is complete, sectioning, staining, grid observation and photomicrographic interpretation are not.

4. Reaction of Mesylate Esters with Energetic Alcohols

Principal Investigator: Major Robert E. Cochoy, Department of Chemistry and Biological Sciences

Associate Investigator: CIC Konrad S. Gruca, Spring 1978 Chemistry 499 Research Project

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

This program was initiated to prepare energetic fluorodinitroethyl ethers for use as plasticizers and binders in explosive and propellant applications. Alkyl methanesulfonates (mesylates) derived from alcohols were proposed as starting materials in lieu of the more expensive alkyl trifluoromethane sulfonates (triflates) derived from alkyl halides currently used.

Butyl mesylate, a model compound, was reacted with fluorodinitro-ethanol catalyzed by a variety of acids and bases. The catalysts that were tried included triethylamine, pyridine, magnesium sulfate, sodium bicarbonate, triflic acid, and trifluoroacetic acid. In order to achieve different reaction temperatures and to accomodate the varying solubilities of the catalysts, a variety of solvents including ether, chloroform, glyme, diglyme, and 1,2-dichloroethane were used.

In all cases, none of the desired alkyl fluorodinitroethyl ether was formed due presumably to the fact that mesylates are so much less reactive than triflates in the  $S_N2$  displacement reaction.

#### Publications

Gruca, Konrad S., May 1978, Final Report for Chem 499.

#### 5. A Spectroscopic Investigation of the Selenium Halides

Principal Investigators: Captain William G. Thorpe, Department of Chemistry and Biological Sciences, and Captain Larry P. David, Frank J. Seiler Research Laboratory (AFSC)

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

This is a new project initiated in November 1977. This project is an investigation of the reaction of helium diluted hydrogen selenide and molecular halogens to produce a chemiluminescent flame. The results are evaluated as to the applicability of this reaction towards a potential chemical laser system. Initial experiments demonstrated a chemiluminescent flame when helium diluted hydrogen selenide and fluorine were mixed. However, there is some question regarding the identity of the emitting species. The analogous reaction involving chlorine in place of fluorine was unsuccessful. In future work, the spectra from the  $H_2Se/F_2$  reaction will be analyzed and compared with theoretical expectations. If the results are promising, laser fluorescence studies will be conducted to determine life-times of selected states.

#### 6. Determination of the Effects of Wastewater Reuse

Principal Investigator: Captain Randal A. Gaseor, Department of Chemistry and Biological Sciences

Associate Investigators: Major Herbert W. Cullers and Major John M. Birkner, Department of Chemistry and Biological Sciences

Sponsored by the Cold Regions Research and Engineering Laboratory, Corp of Engineers, U.S. Army, Hanover, NH

This project is a continuation of one initiated in 1976. The effort of the study has been to examine the wastewater treatment capabilities of the lagoon system at the Air Force Academy. In addition, the monitoring of the terrestrial ecosystem to determine the long term effects of extended wastewater irrigation has been continued. This program is being continued and expanded to include the determination of the effects of aeration on the biological availability of trace metals in wastewater lagoons. Sponsorship has transferred from the Frank J. Seiler Research Laboratory (AFSC) to U.S. Army Cold Regions Research and Engineering Laboratory, and is expected to continue through FY80.

Presentations

Gaseor, R.A. Wastewater reuse research at the USAFA. Dept of Fishery and Wildlife Biology, Colorado State University, Fort Collins, Colorado. November 1977.

Gaseor, R.A. Use of wastewater in golf course irrigation. Educational Session, Rocky Mountain Golf Course Superintendents Association, USAFA, CO. July 1977.

Cullers, H.W. Some aspects of the use of non-potable irrigation on the Air Force Academy golf course. The Irrigation Association 1978 Annual Technical Conference, 26-28 February 1978, Cincinnati, OH.

Sloan, S.K. An investigation of the effects of dissolved oxygen on heavy metal uptake by aquatic plants. Colorado-Wyoming Academy of Science, 49th Meeting, 21-22 April 1978, University of Colorado, Pueblo, CO.

Smith, L.D. An investigation of the uptake and concentration of <sup>65</sup>Zinc in turf grass. Colorado-Wyoming Academy of Science, 49th Meeting, 21-22 April 1978, University of Southern Colorado, Pueblo, CO.

Gaseor, R.A., Cullers, H. W., and Biever, L.J. Some aspects of the use of non-potable irrigation on the Air Force Academy golf course. Proceedings of the 1978 Technical Conference of the Irrigation Association, 26-28 Feb 1978, Silver Spring, MD, pp. 261-264.

Gaseor, R. A. and Biever, L.J. Use of wastewater in turf irrigation. State of Knowledge in Land Treatment of Wastewater, Proceedings of the International Symposium on the Land Treatment of Wastewater, Vol II, Aug 1978, pp. 165-173.

Sloan, S.K., Gaseor, R.A., and Bainter, H.T. An investigation of the effects of dissolved oxygen on heavy metal uptake by aquatic plants. Abstract in the Journal of the Colorado-Wyoming Academy of Sciences, Volume X, in press.

Smith, L.D., Bainter, H.T., and Gaseor, R.A. An investigation of the uptake and concentration of <sup>65</sup>Zinc in turf grass. Abstract in the Journal of the Colorado-Wyoming Academy of Sciences, Volume X, in press.

## 7. An Evaluation of Worldwide Endeavors in Genetic Engineering

Principal Investigator: Captain Robert H. Zellers, Department of Chemistry and Biological Sciences

Associate Investigators: Captain Martin D. Zahn and Captain Robert A. Peterson, Department of Chemistry and Biological Sciences

Sponsored by the Defense Intelligence Agency

This is an on-going evaluation that was begun in FY76. Current research in genetic engineering is being monitored through literature reviews, personal interviews, and attendance at appropriate symposia. Collection of information results in an analysis of trends and progress in genetic engineering efforts with emphasis on potential applications. A final report will be submitted in October 1978.

## 8. Fate of Herbicide Orange in Soils

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. H. H. Cheng, and Mr. Joseph T. Majka, Department of Agronomy and Soils, Washington State University

Sponsored by Air Force Logistics Command

This cooperative field study is being conducted jointly by the Department of Chemistry and Biological Sciences, USAF Academy, and the Department of Agronomy and Soils, Washington State University. The study is attempting to assess breakdown products of both high and low concentrations of 2,4-D and 2,4,5-T n-butyl esters applied at rates comparable to spills in former AFLC Herbicide Storage Sites. A combination of ring and side chain labeled  $^{14}\text{C}$ -2,4-D or  $^{14}\text{C}$ -2,4,5-T n-butyl esters is being used in experiments which will provide data on probable degradation pathways, identification of metabolites, and rates of degradation. Field mini-lysimeters have been installed at the Washington State University Department of Agronomy and Soils Experiment Station. Corresponding microbial analysis is being conducted at the USAF Academy which will correlate levels of herbicide and herbicide metabolites with microorganism populations and diversity.

## 9. Analysis of TCDD in Biological Samples

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. Michael Gross, Department of Chemistry, University of Nebraska

Sponsored by Air Force Logistics Command

In support of the Air Force Logistics Command project on Disposition of Herbicide Orange, the Department of Chemistry and Biological Sciences has been conducting extensive research on the fate of TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin, a contaminant of Herbicide Orange) in the environment. Since 1975, personnel of this department have been collecting soil and biological samples from areas exposed to Herbicide Orange and TCDD. One hundred samples have been collected, placed separately in glass jars and maintained in a freezer pending analysis of TCDD at parts per trillion level (ppt). The analysis of TCDD in biological systems requires a complex extraction and cleanup system in addition to highly sophisticated instrumentation. No Air Force laboratory currently has this capability. Two universities currently do have, but only one (The University of Nebraska) is available. The University of Nebraska is currently under contract to the Department of Chemistry and Biological Sciences, USAF Academy, to analyze these biologicals. A technical report is forthcoming which will summarize all of our past data on the fate of TCDD in biological systems and incorporate the results from the University of Nebraska analyses.

10. Chemical and Microbiological Monitoring of Sites Previously Used for Storage of Military Herbicides

Principal Investigators: Major William J. Cairney, Department of Chemistry and Biological Sciences; Captain Alvin L. Young, Occupational and Environmental Health Laboratory, Brooks AFB, TX; Dr. B. Mason Hughes, Flammability Research Center, University of Utah

Sponsored by Air Force Logistics Command

This study is part of an overall effort by Air Force Logistics Command to reclaim, decontaminate, and restore areas formerly used for the storage of Military Herbicides. The two former storage areas are respectively located at the Naval Construction Battalion Center, Gulfport, Mississippi, and on Johnston Atoll in the Pacific Ocean. The initial phase of decontamination is chemical and microbiological site monitoring. Forty-three sites have been selected at each location for analysis. Test sites were selected on the basis of heavy herbicide spill and heavy herbicide odor (designated H/H), light herbicide spill and odor (designated L/L) and no detectable spill or odor (designated 0/0). In addition controls were selected from locations adjacent to former storage areas which had never received any herbicide. Testing of these sites for 2,4-D, 2,4,5-T, and associated dioxins is in progress and will continue over a two year (or more) period. Levels and diversity of soil microflora are currently being determined and will be correlated with levels of herbicide to assess the possible effects of herbicide on microflora and possibly provide data on the role of microorganisms in herbicide biodegradation. The Flammability

Research Center at the University of Utah is uniquely suited to provide Mass Spectrometric chemical analytical support. Dr. Mason Hughes has personally developed all of the protocol being used and is able to analyze for 2,4-D, 2,4,5-T and breakdown products at a resolution unattainable anywhere else in the world. In addition, he has assembled an automated, computer-linked system which provides rapid results. Present experimental results indicate that high levels of herbicide and dioxin are present in storage site spills. Microbial studies have shown that application of 2,4-D and 2,4,5-T at massive rates (5000-40,000 ppm) not only did not sterilize the soil, but actually stimulated the growth of some soil micro-organisms. This next set of samples (programmed for October-November 1978) will begin to yield data on breakdown rates in the two storage sites.

#### 11. The Effect of Hyperbaric Oxygen on Mycotic Disease Agents

Principal Investigator: Major William J. Cairney, Department of Chemistry and Biological Sciences

This research is presently unsponsored. The project attempts to determine oxygen toxicity limits for selected mycotic disease agents in an effort to find expanded application for the USAF Compression Chamber Treatment Facilities (i.e., Hyperbaric Chambers). Students in English 330 and Bio Sci 499 are programmed to do literature review and experimental studies on the project. Preliminary results indicate that a number of mycotic disease agents have oxygen toxicity limits within levels readily tolerated by susceptible humans and animals.

#### Publication

Cairney, W. J. 1978. Effect of hyperbaric oxygen on certain growth features of *Candida albicans*. *Aviat. Space Environ. Med.* 49(8):956-958.

#### 12. Chemical Structure/Bonding Decomposition Relationships

Principal Investigator: Major Joel W. Beckmann, Department of Chemistry and Biological Sciences

Associate Investigators: Captain R. Martin Guidry, Captain Larry P. Davis, Lt John S. Wilkes, Frank J. Seiler Research Laboratory; C1C Robert Wheelock, C1C Craig Gilbert, Department of Chemistry and Biological Sciences

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

Two areas of study were conducted as Chemistry 499 projects under the supervision of Major Beckmann.

a. The objectives of CIC Gilbert's project were the isolation and identification of the catalytic precursor to the thermal decomposition of Trinitrotoluene (TNT). This project resulted in identification of the catalytic precursor as 4,6-dinitroanthranil. Also, the formation of 4,6-dinitroanthranil fits nicely into a mechanism for TNT thermal decomposition proposed by Capt Shackelford.

b. The objective of CIC Wheelock's project was to investigate the decomposition mechanism of hexanitrostilbene (HNS) via the kinetic isotope effect expected from the replacement of the allytic protons with deuteriums. This effect is used to help determine whether the C-H/C-D bond breakage in HNS and similar compounds such as TNT is rate determining. The kinetic results obtained were inconclusive; however, they provided two major improvements in the current experimental procedure; computer data acquisition and a variation in the synthetic technique for deuterated HNS.

### 13. Citizen's Workshop Program on Energy and the Environment

Principal Investigator: Captain Ronald E. Channell, Department of Chemistry and Biological Sciences

Associate Investigators: Lt Colonel Hugh T. Bainter, Major John H. Birkner, Major James R. Wright, Captain Elroy A. Flom, Captain John A. Klube, Captain James T. Norelius, Captain Donald A. Potter, Captain Ronald E. Watras, Department of Chemistry and Biological Sciences; Dr. Phil Kearney, Colorado State University, Fort Collins, CO; Dr. Mike Lowenstein, Navarro College, Corsicana, TX; Mr. Roger Howard, West Junior High School, Grand Junction, CO

Sponsored by the Department of Energy through Interagency Agreement

Citizen's Workshops are educational programs that give citizens an opportunity to learn more about energy and environmental needs and problems. Participants get a chance to try their hand at solving some of the energy-environment problems facing the nation today by using an Energy-Environment Simulator.

The Energy-Environment Simulator is a specially designed analog computer that simulates real-world conditions. Energy resources, energy demands, and environmental effects are programmed into the electronic device. As the clock speeds time by at the rate of a century a minute, participants must make decisions about the allocation of energy resources. They do this by operating controls on remote panels in response to the changing situation.

The simulator constantly translates these commands into new conditions. The sequence continues until all the fossil fuels are exhausted--and the game ends.

The workshops now being scheduled have as many as three parts: (1) a slide orientation dealing with the basic facts related to energy problems; (2) a decision-making game played by participants using the Energy-Environment Simulator to observe the effects of a wide range of decisions involving energy use and environmental protection; and (3) a feedback session where questions raised by the program are discussed.

During FY78 the Citizen's Workshop Program was responsible for conducting 230 presentations to a total audience in excess of 10,500 people. This level of activity has ranked the USAFA program in the top 15 percent nationally in 8 out of the 12 reporting periods and in the top 10 percent in 3 out of the 12 reporting periods. The contract requires that a total of 20 presentations be given during the fiscal year. The USAFA program has averaged 19 presentations per month. The USAFA will retain the contract for FY79.

14. Comparison of Stress Responses in Male and Female Cadets at the USAF Academy

Principal Investigators: Lt Colonel Orwyn Sampson, Lt Colonel Hugh T. Bainter, and Major John B. Bomar, Department of Chemistry and Biological Sciences

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

This project consisted of a pilot study in which 50 female subjects from the Class of 1980 were examined in terms of their response to the stresses of medium altitude and the Basic Cadet Training Program at the Air Force Academy. The parameters of study included 6 hematology and 18 serology variables. Samples were taken at the beginning and throughout BCT. Baseline data were obtained and analyzed using a least squares fit computational technique.

A continuation of this project to include a longitudinal comparison of cadet male and female stress responses was envisioned. However, this has been determined to be impractical because of time and manpower constraints. A final report will be submitted in November 1978.

Publications

Cote, R.W., Bomar, J.B., Robertshaw, G.E., and Thomas J.C. 1977. Maximal aerobic power in women cadets at the U.S. Air Force Academy. *Aviation, Space, and Environmental Medicine* 48(2):154-155.

## 15. Physical and Electrochemical Measurements

Principal Investigator: Dr. J. S. Wilkes

Associate Investigators: Lt Colonel L. A. King, Major A. A. Fannin, Jr., Captain R. A. Carpio, and CIC D. L. Schwartzenbach

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

Work was centered on physical properties of potential molten salt battery electrolytes. Density and conductivity data for the  $\text{LiCl}-\text{AlCl}_3$  system were obtained in the liquid range and reduced to functions of temperature and mole fraction. The liquidus diagram for the low-melting ternary  $\text{KCl}-\text{NaCl}-\text{AlCl}_3$  was fitted. Preliminary fits of density for  $\text{LiAlCl}_4-\text{NaAlCl}_4-\text{AlCl}_3$  were made and reduced to equation form. A generalized polynomial fitting routine based on minimum distance techniques for the above measurements.

### Paper

"The  $\text{KCl}-\text{NaCl}-\text{AlCl}_3$  Phase Diagram," ACS Meeting-in-Miniature, 29 April 1978, Colorado State University. D.L. Schwartzenbach and A.A. Fannin, Jr.

### Publications

"Vapor Pressure of Aluminum Chloride Systems. 2. Pressure of Unsaturated Aluminum Chloride Gas," J.T. Viola, A.A. Fannin, Jr., L.A. King, and D.W. Seegmiller, J. Chem. Eng. Data, 23, 118 (1978).

"Vapor Pressure of Aluminum Chloride Systems. 3. Vapor Pressure of Aluminum Chloride-Sodium Chloride Melts," J.T. Viola, L.A. King, A.A. Fannin, Jr., and D.W. Seegmiller, J. Chem. Eng. Data, 23, 122 (1978).

"Densities of  $\text{AlCl}_3$ -Rich Molten  $\text{AlCl}_3-\text{LiCl}$  Systems," R.A. Carpio, L.A. King, and A.A. Fannin, Jr., submitted to J. Chem. Eng. Data

"Conductivities of  $\text{AlCl}_3$ -Rich Molten  $\text{AlCl}_3$  Mixtures," R.A. Carpio, L.A. King, F.C. Kibler, Jr., and A.A. Fannin, Jr., submitted to J. Electrochem. Soc.

### Patents

"Aluminum-Chlorine Thermal Battery," L.A. King, G.D. Brabson, Jr., J. K. Erbacher, D.W. Seegmiller, A.A. Fannin, Jr., and J.T. Viola, U.S. Patent No. 4,063,327; December 1977.

"Electrolytic Separation Procedure for Removing Aluminum From a Solid Two Phase Mixture of Aluminum and Trialuminum Nickelide," C.L. Hussey, J.C. Nardi, L.A. King, J.K. Erbacher, and A.A. Fannin, Jr., U.S. Patent applied for, Serial No. 816,223, July 1977.

"Molybdenum Chloride-Tetrachloroaluminate Thermal Battery," J.C. Nardi, C.L. Hussey, J.K. Erbacher, L.A. King, and A.A. Fannin, Jr., U.S. Patent applied for, Serial No. 842,141, October 1977.

#### 16. Chemiluminescent Gas Phase Reactions

Principal Investigator: Major Chester J. Dymek, Jr., Department of Chemistry and Biological Sciences

Sponsored by the Frank J. Seiler Research Laboratory, Air Force Systems Command (AFSC)

This project involves determination of critical data relevant to the chemical laser system based on chemical generation of  $O_2(\Delta)$  and subsequent transfer to atomic iodine, the lasing species. Using an ESR spectrometer to measure  $O_2(\Delta)$  and  $O_2(\Sigma)$  generated by microwave discharge of  $O_2$ , we determined an upper limit to rate of quenching of  $O_2(\Delta)$  by  $Cl_2$  of  $10^{-16}$  cc/molec-sec. A generator based on the  $Cl_2/H_2O_2$  (basic) reaction has been constructed for use in mechanistic and quenching studies. Runs of long duration (over one hour) have produced steady outputs of  $O_2(\Delta)$  in percentages exceeding 25%. Variations in generator parameters has begun and much useful information on its performance has already been obtained.

#### D. Department of Civil Engineering, Engineering Mechanics and Materials

##### 1. Bio-Engineering

Principal Investigator: Major Will Stackhouse, Department of Civil Engineering, Engineering Mechanics and Materials

This work concentrated on the adaptation of a platform-type lower limb prosthetic device. The adaptation involved the addition of two pairs of manually controlled hydraulic actuators, one pair at the knees and the other pair at the hips. The end product, a walking machine, was adapted, in two prototypes, to sit and to climb stairs.

##### Publications

"Design and Development of a Walking Mechanism Adapted to Sit and Climb Steps," PhD Thesis, Oxford University, Oxford, England, 1978.

## 2. Certification of Side Facing Troop Seats for the UV-18 Aircraft

Principal Investigator: Captain Glenn R. Leimbach, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigator: Major John Russell, Department of Civil Engineering, Engineering Mechanics and Materials

A structural analysis was accomplished on the seat belt attachment mechanism for the Academy's UV-18 aircraft. This study proved that the assembly could withstand the required load factors set forth in Federal Aviation Regulation, Part 23, Paragraph 23.561. This report was then used to obtain FAA certification for the Academy's UV-18s. The certification allowed the Airmanship Division to carry the maximum number of cadet jumpers per flight and therefore increase the efficiency of their jump program.

### Presentation

"Certification of Side Facing Troop Seats for the UV-18 Aircraft," presented to the Federal Aviation Administration, March 1978.

## 3. Development of General Second Order Component Mode Synthesis With Application to Rotor Bearing Systems

Principal Investigator: Captain David A. Glasgow, Department of Civil Engineering, Engineering Mechanics and Materials

A method of component mode synthesis has been developed which is applicable to general linear second order systems to include general viscous damping and nonsymmetric stiffness and damping terms. Computer programs used in the analysis have been successfully applied to numerous rotor bearing systems resulting in whirling modes and stability information. Analyses are complete for general forced response due to maneuver loads, unbalance, and blade loss dynamics. Computer codes for the forcing problem are under development. Two technical papers and one technical note are under preparation.

## 4. Dynamics of Aircraft-Runway Interaction

Principal Investigators: Lt Colonel Joseph J. Cox, Jr., Lt Colonel William M. Henghold, Major John J. Russell, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigators: Captain Ralph R. Gajewski, Captain Stoney Chisom, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Civil and Environmental Engineering Development Organization (CEEDO), Tyndall AFB, FL

The project, Aircraft Response to Bomb Damaged Runways, has concentrated on a literature search and a review of past studies of the dynamics of aircraft-runway interaction. Work efforts have focused on better ways of computer solutions than integrating the equations of motion for the varied inputs. A "Modal Analysis Seminar" given by Structural Dynamics Research Corporation with attendees from Tyndall AFB and Edwards AFB is scheduled for 18-20 Oct 78. This consulting research project is scheduled to continue through 1985.

#### Publication

"A Literature Search and Review of the Dynamics of Aircraft-Surface Interaction," 1 June 1978. (To be published as a technical report.)

#### 5. Elastic Waves in Layered Media

Principal Investigator: Captain Ralph R. Gajewski, Department of Civil Engineering, Engineering Mechanics and Materials

Exact solutions for elastic waves in layered media are obtained using concepts of generalized rays and Cagniard's method for Laplace transforms. Displacement responses for various sources have been numerically obtained. Response of a layered geology to pressure inside a finite spherical cavity has been used to check performance of large scale finite difference ground motion codes. Response of a plate to a single point force provides a basis for analyzing the signals recorded in acoustic emissions.

#### Publications

"The Generalized Ray-Theory and Transient Response of Layered Elastic Solids," Physical Acoustics, Vol XIII, December 1977.

"Transient Response of Layered Elastic Solids to Uniform Pressure on a Spherical Cavity," PhD Dissertation, Cornell University.

#### 6. Finite Element Cable Studies

Principal Investigators: Lt Colonel William M. Henghold and Major John J. Russell, Department of Civil Engineering, Engineering Mechanics and Materials

Work continued in the nonlinear finite element analysis of cable structures. A study was performed on the effects of certain parameter variations upon cable natural frequency. The theory was developed and a computer program written for the problem of equilibrium shape and stability of cables under the influence of a steady wind.

Publication

"Equilibrium and Stability of a Cable in a Steady Wind," by W. M. Henghold and J. J. Russell, *Journal of the Structural Division, ASCE*, pp 301-311, February 1978.

Presentation

"Equilibrium and Stability of a Cable in a Steady Wind," by W. M. Henghold and J. J. Russell (presented by Lt Col Henghold), *A.S.C.E. Winter Annual Meeting, San Francisco, October 1977.*

7. Fracture Mechanics

Principal Investigator: Major Thomas E. Kullgren, Department of Civil Engineering, Engineering Mechanics and Materials

The finite element-alternating method is applied to problems of semi-elliptical cracks in irregular bodies. This three-dimensional solution method produces mode-one stress intensity factors along the crack periphery and crack opening displacements. Results are available for three crack configurations adjacent to both open and loaded fastener holes in plates. Two follow-on technical papers are under preparation.

Publications

"Quarter Elliptical Cracks Emanating From Holes in Plates," Journal of Engineering Materials and Technology, Vol 100, pp 144-149, 1978.

8. High Speed Ground Transportation

Principal Investigator: Lt Colonel Joseph J. Cox, Jr., Department of Civil Engineering, Engineering Mechanics and Materials

The project, High Speed Ground Transportation, has developed a constrained optimization algorithm to maximize the operating speed of a fifteen degree-of-freedom lateral dynamic model for a passenger railcar subject to random alignment irregularities. Significant increases in the speed where a lateral instability begins can be obtained by choosing the optimum values of the suspension system parameters. Additional work is planned for model improvement over the next two years.

Presentation

"Optimization of Rail Vehicle Operating Speed with Practical Constraints," *ASME Winter Annual Meeting, San Francisco, CA, December 1978.*

### 9. Hot Corrosion

Principal Investigator: Major George W. Watt, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the National Science Foundation

The research has been divided into two main areas of investigation. The first has been to study the electrochemical probes that are typically used as reference electrodes in molten  $\text{Na}_2\text{SO}_4$ . The second part of the research involves the electrochemical study of corroding samples of chromium, nickel and nickel-aluminum alloy under a thin film of  $\text{Na}_2\text{SO}_4$ . The experimentation has been completed and the data is being analyzed.

### 10. Load Deformation Relationship for Split-Ring Timber Connectors

Principal Investigator: Lt Colonel Dwayne D. Piepenburg, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Weapons Laboratory (AFWL), Kirtland AFB, New Mexico

The purpose of this project was to develop load-deformation curves for varying end and edge-distances on split-ring shear connectors using a special phenolic-impregnated wood. Included in this purpose statement was the need to establish an average ultimate strength of the shear connectors, establish the effects of end and edge distance on ultimate strength and to gain a better understanding of the failure mechanism. Results were obtained for combinations of five end distances and four edge distances. Best-fit load deformation curves have been plotted for these data. Interim technical reports have been prepared and a final technical report is in preparation and will be published in December 1978.

### 11. Metal Joining Techniques

Principal Investigator: Captain Patrick K. Talty, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Department of Energy and Lawrence Livermore Laboratory

This project will provide the Department of Energy (DOE) with expertise in metal joining. Consulting activities with DOE will center around problems occurring in nuclear weapons production and metal joining equipment operation.

## 12. Solar Energy

Director: Colonel Wallace E. Fluhr, Department of Civil Engineering, Engineering Mechanics and Materials

Principal Investigator: Captain Anthony Eden, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigators: Captain Kenneth A. Cornelius, Captain Joel D. Benson, and Captain Gregory E. Riggs, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Systems Command (AFSC) through the Civil and Environmental Engineering Development Organization (CEEDO)

The project, Solar Heating Retrofit of Military Family Housing, has concentrated on the gathering of performance data and its analysis to determine the effects of the various parameters on overall system efficiencies. Work efforts have focused on optimization of the major controlling variables and solutions to the problem associated with the operation of the solar energy systems. An additional year of tests and evaluations centered on evacuated-tube solar energy collectors is planned.

### Publications

"Solar Energy Program at the Academy," Air Force Engineering and Services Quarterly, February 1978.

"The Application of Thermography to Large Arrays of Solar Energy Collectors," Solar Energy, September 1978.

"Third Interim Technical Report on the USAFA Solar Test House-Design Parameters," CEEDO TR-78-32, September 1978.

### Presentations

"USAFA Solar Test House Laboratory," Pikes Peak Solar Energy Association, March 1978.

"USAFA Solar Test House Laboratory and Retrofit Aspects of Solar Energy" Our Savior's Lutheran Church Growth School, April 1978.

"Retrofitting with Solar Energy," SUNDAY activities of the University of Colorado, Colorado Springs, May 1978.

13. Tension-Torsion Interaction Strength of Laminated Wood Bolts

Principal Investigator: Lt Colonel Dwayne D. Piepenburg, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Weapons Laboratory (AFWL), Kirtland AFB, New Mexico

The purpose of this project was to develop the strength of wood laminated bolts under tension and combined tension and torsion loads. Included in this purpose statement was the need to establish the effect of moisture on the strength of the bolts, and to gain an understanding of the failure mechanism. Test results were obtained for 120 wood bolts. An interim technical report has been submitted to the project officer. A final technical report is in preparation and will be published by December 1978.

14. T-38 Structural Integrity

Principal Investigator: Captain Dale K. Carter, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigator: Captain Paul I. King, Department of Aeronautics

Sponsored by the Tactical Air Command in conjunction with San Antonio Air Logistics Center (AFLC/SAALC)

This project provided TAC and SAALC with an independent assessment of potential problems with the T-38 primary structure resulting from use of the aircraft in a Lead-In-Fighter training role. The feasibility of establishing a permanent on-site engineering team at Holloman AFB was also assessed.

Publication

"On-Site T-38 Structural Integrity Review," Final Report, September 1978.

15. Turbine Engine Metal Matrix Composite Blade Analysis

Principal Investigator: Captain Paul D. Copp, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio

This project consists of an analytical study of two phenomena. The first study, entitled "J-79 Boron/Aluminum FOD Transient Impact Analysis," deals with Foreign Object Damage (FOD) resulting from bird strikes on jet engine compressor blades. The second study, entitled "Dynamic Composite Laminate Finite Element Analysis," considers the behavior of composite structures under dynamic loading conditions. Both NASTRAN and SAP IV computer codes are used in this work.

## 16. Wind Energy Conversion System (WECS)

Principal Investigator: Major Thomas E. Kullgren, Department of Civil Engineering, Engineering Mechanics and Materials

Associate Investigators: Major Thomas Finley, Major Dennis Wiedemeier, Captain Gary Brown, Captain John T. Tinsley, Department of Civil Engineering, Engineering Mechanics and Materials

Sponsored by the Air Force Systems Command (AFSC) through the Civil and Environmental Engineering Development Organization (CEEDO)

The USAF Academy WECS project has two parts; the design, fabrication and testing of a small vertical axis wind turbine (VAWT) and the analysis of USAF Academy winds for future large wind turbine siting. The VAWT was erected in August 1978 and is undergoing initial controlled testing. The wind site survey began in September 1977 with one anemometry location and will be expanded to four sites in FY 79. An interim technical report covering work on the VAWT is scheduled for publication in January 1979.

### E. Department of Electrical Engineering

#### 1. Space Test Program Experiment Prioritization

Principal Investigator: Major Steven K. Dingman, Department of Electrical Engineering

Associate Investigator: Captain Raymond J. Leopold, Department of Electrical Engineering

Sponsor: Director of Space, Headquarters, USAF

The Space Test Program (STP) involves the launch of DoD sponsored experiments with the Director of Space, USAF, as the executive agent for the DoD. Space test program experiments are secondary payloads that do not have sufficient priority for a dedicated launch. In the past there has been no formal rationale for the method of establishing the order of launch for these STP experiments. This investigation is providing the Director of Space with explicit criteria, procedures, and recommendations concerning STP priorities.

#### 2. Microprocessor System Development for Aircraft Simulation Visual System Control

Principal Investigator: Captain Joseph J. Pollard, Department of Electrical Engineering

Associate Investigators: Captain Alan R. Klayton, CIC Michael L. Baumgartner, CIC John McCormack, Department of Electrical Engineering

Sponsor: Rome Air Development Center Post-Doctoral Program and Air Force Flight Dynamics Laboratory

The purpose of this project is to develop and interface a high speed state-of-the-art microprocessor system (16-bit Intel 8086) to a complex hybrid simulation facility located in the Flight Control Division of the Flight Dynamics Laboratory at Wright-Patterson AFB. This system will be user programmable, hybrid, and possess high speed, high accuracy arithmetic capability to maximize throughput and hence accuracy in the closed loop visual system control problem. The processor developed will be generally applicable to other high speed, high accuracy real-world control problems.

### 3. Portable, Self-Contained, Educational Microprocessor System Development

Principal Investigator: Captain Joseph J. Pollard

The purpose of this project was to develop a portable microprocessor system for educational use. The design was constrained to use a single five volt power supply. The system was designed around a Zilog Z-80 microprocessor--it has been built, tested, and is now in full operational use. It is completely self-contained with keyboard and display and has operated on a battery pack of four "D" cells. This microcomputer is affectionately known as EDUPICO and is projected for student use in the computer track of the Electrical Engineering major. The Air Force Communications Service and the Air Force Armament Laboratory are considering EDUPICO for possible research and training applications.

### 4. Microprocessor Instrumentation of the F-15 APG-63 Radar

Principal Investigator: Captain Frederick Cruger, Department of Electrical Engineering

Sponsor: Air Defense Weapons Center, Tyndall AFB, Florida

This project involves the development of a microprocessor system to control and monitor a production model of the APG-63 radar mounted in an elevated tower telemetry site at Tyndall AFB. A detailed hardware/software design for the bus controller will be completed and an Intel 8085-based microprocessor system with RAM, ROM, UART, bus drivers, and standard documentation will be developed.

## 5. Data Acquisition System Development

Principal Investigator: Captain John R. Maneely, Department of Electrical Engineering

Sponsor: Central Inertial Guidance Test Facility (CIGTF), Holloman AFB, New Mexico

The purpose of this research project is to develop a special purpose digital data acquisition system to acquire precise performance information from inertial guidance components being evaluated for use in Air Force weapons systems. The data acquisition system will be a digital processor which acts as an interface between test instruments and a minicomputer which analyzes and stores test data. When completed, the new data acquisition system will replace a less capable system now employed by the CIGTF.

## 6. Bulk Properties of Annealed High Resistivity Gallium Arsenide

Principal Investigators: Major Albert J. Rosa and Captain Howard N. LaValley, Department of Electrical Engineering

Sponsored in part by the USAF Avionics Laboratory

The intent of this research is to study Hall Mobility, resistivity and carrier concentrations in high resistivity samples of Gallium Arsenide which has been subjected to a high temperature (700 - 800°C) anneal in a reducing ( $H_2$ ) atmosphere. Current efforts are directed toward developing a computer controlled high resistivity, temperature controlled Van der Pauw measurement system. Of this a prototype Dewar temperature controller has been successfully constructed that maintains sample temperatures to within  $\pm 0.1^\circ K$  of a selected temperature over a range of 77° - 400°K.

## Publications

Major Albert J. Rosa and B. G. Streeman, "Characterization of the Edge Emission in Sodium Doped Zinc Selenide." Journal of Luminescence, Jan 1978.

## 7. 6502 Microprocessor Emulator System

Principal Investigator: Captain Louis M. Ayers, Department of Electrical Engineering

Sponsored by Research Probe Branch, Air Force Geophysics Laboratory, Air Force Systems Command

This research investigates microprocessor emulation techniques, emphasizing their application to the MOS Technology 6502 Microprocessor. Following this investigation, an enhanced 6502 instruction set will be developed and implemented, using an AMD 2903 bit-slice microprocessor chip set. Current efforts are directed toward the construction of a 6502 development system.

#### 8. Space Experiment Integration

Principal Investigator: Captain John A. Criscuolo, Department of Electrical Engineering

Sponsored by Director of Space Systems, Space and Missile Systems Organization, Los Angeles, California

Long lead times and increasing costs make engineering planning of new space experiments especially critical to program success. Optimum techniques and engineering trade-offs for integrating a space experiment (payload satellite) on board a booster vehicle were researched, analyzed, and reported.

#### Presentation

Formal report and briefing to Director of Space Systems, Space and Missile Systems Organization, Los Angeles, California

#### 9. Educomm - An Analog Communications Trainer

Principal Investigator: Captain Barry L. Mitchell, Department of Electrical Engineering

This research involves designing a state-of-the-art analog communications trainer. The trainer is modular, using printed circuit boards in individually shielded enclosures which plug into an inexpensive multipurpose card enclosure. Modules are designed to simplify student access and module interchangeability. Modules, or groups of modules from this trainer will also be used to implement commonly used functions for future research projects.

#### 10. Microcomputer Controlled Event/Alarm Scanner

Principal Investigators: Captain John R. Schmidt and CIC Michael D. Verstegen, Department of Electrical Engineering

Sponsored by the Air Force Communications Service

The intent of this research is to design and build a microcomputer to support the communications test bed, a system for testing and checkout of communications equipment. The microcomputer acts as a monitor and control for the entire system which is interfaced to the IEEE 488 bus.

## Publications

### Technical Report in Press

#### 11. Measurement of Surface Charge and Currents Utilizing Infrared Technology

Principal Investigator: Lt Colonel Robert W. Burton, Department of Electrical Engineering

Sponsored by Rome Air Development Center, AFSC

The detection and accurate measurement by probes of surface current density distributions is a tedious and costly experimental process. A technique for the rapid measurement of the magnitude of these distributions by an infrared scanner has been developed. By utilizing the small but significant I<sup>2</sup>R heating effects of the surface current on antennas and scatterers with prepared surfaces, thermal distributions are measured and quantized into various color levels and presented on color-TV monitor.

## Publications

King, R.W.P., Burton, R.W. "Surface Currents and Charges on an Electrically Thick and Long Conducting Tube in E- and H- Polarized, Normally Incident, Plane-Wave Fields," Radio Science, V. 13, No. 1, pp. 75-91, Jan-Feb 1978.

Burton, R.W., King, R.W.P. "Surface Currents and Charges on Crossed Electrically Thick Cylinders in a Normally Incident, Plane-Wave Field," Radio Science, V. 13, No. 1, pp. 93-105, Jan-Feb 1978.

King, R.W.P., Burton, R.W. "Currents and Charges Induced by a Normally Incident Plane Wave on Single and Crossed Tubular Cylinders with  $ka = 2$ ," Radio Science, V. 13, No. 1, pp. 107-119, Jan-Feb 1978.

Burton, R.W., Selim, J.D., "Rapid Detection of Charge and Surface Current Distributions on Radiating and Scattering Structures," Proc. National Radio Science Meeting of the International Union of Radio Science, Boulder, Colorado, p. 60, January 1978.

Burton, R.W., Russell, W.C. "Further Work on the Infrared Detection of Surface Current and Charge Distributions," Proc. of the International Union of Radio Science, USNC/URSI, 1978 Spring Meeting, Washington, D.C., p. 138, May 1978.

Burton, R.W. "Real Time Infrared Detection of Surface Current Density Distributions," Proc. of the 8th European Microwave Conference, Paris, France, Sept 1978.

## F. Department of Mathematical Sciences

### 1. Transhipment/Allocation Algorithm for Cadet Summer Transportation Requirements

Principal Investigator: Major Daniel W. Litwhiler, Jr., Department of Mathematical Sciences

Sponsored by the Department of Mathematical Sciences, USAFA

The goal is to develop an interactive algorithm to improve existing methods used by Cadet Wing Operations in determining requirements and routing of military aircraft for cadet summer transportation. Currently requirements and routes are determined merely by inspection. There is a potential for saving thousands of dollars in transportation costs, along with many manhours required for the current technique. A heuristic algorithm is being developed which consists of two stages; one a location problem to determine n "good" bases to be serviced by military air, and the other to determine aircraft requirements and routes to be flown to the n bases. The first phase has been modelled and solved, and work is currently being done on modelling the second phase. Upon completion of the second phase of the algorithm, data for the past year's transportation requirements will be used to compare the manual solution against the heuristic solution. Refinements in the algorithm will then be made, if required. The intent is then to have the algorithm coded so that it can be used in the future in an interactive mode by CWO personnel on the USAFA computer system.

### 2. Safe Escape

Principal Investigators: Lt Colonel William T. Hodson, Major Joseph C. H. Smith, Major Roy R. Kilgore, Captain Joseph B. Williams, Department of Mathematical Sciences

Sponsored by the Air Force Weapons Laboratory

The project goal is to develop an analytical model of the process of aircraft attempting to escape from the vicinity of their base while under attack by an enemy missile force. The model will enable the user to: (a) make quantitative comparisons among different aircraft types with respect to their ability to escape from base safely, (b) compare possible alert force bed downs with respect to safe escape; and (c) develop nuclear hardness versus flight performance tradeoffs.

The study began in January 1978 at the request of the AFWL/NT. The problem is highly significant with the current commitment to the cruise missile as a primary deterrent, and with the possibility of the Soviets having a depressed trajectory capability for their SLBMs. At this point, the basic structure of the problem has been formulated and analyzed. The methodologies

for determining the aircraft region of uncertainty and aircraft vulnerability region have been developed. Also, we have developed and tested the procedure for combining the region of uncertainty and the vulnerability region into an integer linear programming problem to either minimize the number of weapons to assure a zero probability of escape, or to minimize the probability of escape given a fixed number of weapons.

### 3. Digital Signal Sorting

Principal Investigator: Captain Roger Salters, Department of Mathematical Sciences

Sponsored by the Air Force Avionics Laboratory

This project concerns the investigation of signal process techniques that will allow the identification of the analog source(s) of the digital data in a communication network. In particular, a decision directed algorithm is being developed that will recognize whether the parent analog source is speech or non-speech. The approach is based on the unique dynamic characteristics of the speech generation process that are independent of the language being spoken. The invariants of the speech generation process appear to be the well defined clustering neighborhood of the predictor coefficients of an auto regressive-integrated-moving average (ARIMA), pole-zero model, of the transfer function of the vocal tract. The classification process employs some concepts from distortion-rate theory, and the eigenvalues of the covariance matrix of a speech process.

### 4. Development of a Fix Computation Algorithm for Use in High-Frequency Direction-Finding Systems

Principal Investigators: Lt Colonel William T. Hodson and Major Joseph C. H. Smith, Department of Mathematical Sciences

Sponsored by the Naval Security Group Command

The purpose of this project was to develop an improved fix computation algorithm for use in Army, Navy and Air Force HF/DF systems. The effort was sponsored by the Naval Security Group Command and was begun in April 1977. The computerized algorithm which was developed provides a 10-20% increase in fix accuracy and a similar reduction in the "no-fix/wild-fix" rate over the best currently available algorithm. The algorithm has been developed, coded in FORTRAN, and delivered to Naval Security Group Command. The program is currently undergoing final acceptance testing by the sponsor. At such time as the code is accepted, a copy will be provided to Air Force Security Service and the cognizant Army organization.

## 5. Mathematical Modeling and Identification

Principal Investigators: Major Donald C. Washburn, Major Raymond M. Zazworsky, and Captain David Jensen, Department of Mathematical Sciences

Sponsored by the Frank J. Seiler Research Laboratory

The purpose of this research effort is to study the problem of generating internal state space system models from external system measurements. The approach to this problem is based on the theory of minimal realizations. During the last year a computer program was developed which will (1) construct minimal partial realizations given a finite sequence of Markov parameters; (2) construct a minimal complete realization given the system's transfer matrix; and (3) construct a minimal data set realization given specific values of the system's transfer matrix. Future studies will be related to (1) obtaining stable minimal realizations; (2) obtaining minimal realizations given noisy data; and (3) obtaining linear models of stochastic processes.

## 6. Network Evaluation Through Simulation

Principal Investigators: Lt Colonel Jay D. Sherman, Major Brian E. Esterby and Major Joseph C. H. Smith, Department of Mathematical Sciences

Sponsored by the AF Technical Applications Center

Network Evaluation Through Simulation is a digital computer model to simulate the detection and identification of subsurface nuclear explosions by a specified seismic network. This model is designed to enable AFTAC to evaluate its detection and identification capabilities under a variety of scenarios. During the summer of 1976, the investigators developed the basic simulation model, which incorporates many aspects of the explosion versus earthquake identification process that were not previously available in the AFTAC library of computer models. The model was validated against existing models insofar as they were compatible. Technical experts at AFTAC verified the model's outputs for new features. Revisions to the model combined closed form probability calculations for detection of seismic events and a Monte-Carlo simulation for identification and location of epicenters. A second product to plot constant network capability contours for a non-standard grid of epicenter locations was also delivered.

## 7. USAFA/DMA R&D Program

Principal Investigators: Major John D. Maybee and Captain Eden Y. Woon, Department of Mathematical Sciences

Sponsored by the Defense Mapping Agency

The primary purpose of this effort is to support the Defense Mapping Agency (DMA) in R&D projects of interest and importance to DMA. The initial effort is directed at the problem of generating 3-D models of urban centers based on stereo digital imagery. A secondary purpose of the effort is to provide hardware/software spinoff benefits for possible classroom use. To date, project work has been concentrated in three areas: Literature search; attendance at relevant conferences; and efforts to procure necessary computer/image processing hardware. The latter area has involved extensive work to precisely identify the hardware needs and to comply with DOD/AF/USAFA procurement requirements. Numerous delays have been encountered in wading through a myriad of red tape associated with ADPE procurement. We are hopeful that the equipment will be delivered in the spring of 1979. Until the delivery takes place, research efforts will concentrate on literature research and analysis of the specified problem. After delivery, the effort will be directed at gaining expertise on the use of the equipment and the subsequent development and implementation of algorithms as a primary product goal of the research effort.

#### 8. Shock Waves in Explosives

Principal Investigator: Lt Colonel James E. Wade, Department of Mathematical Sciences

Sponsored by the Frank J. Seiler Research Laboratory, AFSC

The objective of this project is to model the shock wave traveling in an explosive with the Shock-Hugoniot equations to yield pressure predictions having better agreement with measured pressures, even though the measured pressure pulses display scatter in many experiments. The work has consisted of an assessment of the Shock-Hugoniot equations with a decided emphasis on waves in explosives and the intractabilities of a non-normal shock wave traversing the explosive. Study of various experimental results on the measurement of pressure data in explosive specimen have been accomplished to gain an appreciation of the sources of experimental error and to gain the unique or peculiar manner in which final experimental data were obtained; i.e., matching of the interface conditions as waves travel into media with different specific acoustic impedances or the synthesizing of the recorded electrical signals with a computer code with specific assumptions which the experiment did not reflect: review of the textbook approach to shock waves in chemistry and physics. Due to the departure of key personnel, this effort in energetic materials was terminated. The following final report has been published: "Parameterization of the BKW and JCZ Equations of State for Explosives," FJSRL-TR-78-0003, dated June 1978.

#### 9. An Encke Method in Poincare'-Similar Elements

Principal Investigator: Lt Colonel Hayes R. Bryan, Department of Mathematical Sciences

Sponsored by the Frank J. Seiler Research Laboratory, AFSC

The "Encke Method" title refers to a technique of numerically integrating the difference between an analytically known approximation of a satellite orbit and a more accurate but analytically unsolvable model of the orbit. The object is to obtain more efficient numerical computation of the motion than would be obtained by integrating the accurate model alone. This was previously done with Scheifele's "Delaunay-Similar" elements, and found to reduce computation time by some 35% in some situations. However, applying the same technique to Scheifele's Poincare"-Similar (P-S) elements proved to be inefficient. The form of the differential equations involved in the P-S elements was such that the Encke method involved a greatly increased number of mathematical terms. This increased the computation time required and outweighed the benefits of the method. The study did produce some results, however. The analytic solution to the motion involving the Earth and J-2 harmonic was derived in a straightforward manner, replacing the circuitous derivation that was previously known.

G. Department of Physics

1. A Study of Proton Range "Straggling" Due to Initial Beam Energy Distribution

Principal Investigator: Captain Brian J. Kohn, Department of Physics

Sponsored by Major Harold Dogliani, DYP, Air Force Weapons Laboratory, Kirtland AFB, NM

The range of a proton incident upon a target material is dependent upon its energy. Range straggling is the result of a statistical distribution of ranges about a mean range in a mono-energetic beam of particles due to scattering processes in the target. The purpose of this study was to calculate an additional "straggling" effect in a beam of protons due to an initial distribution of proton energies about a mean value. An existing deposition computer code was modified to accept an initial Gaussian beam energy distribution and predict the resulting range dispersion in a target. Based on a large number of computer runs, an empirical technique was devised to predict the magnitude of the range "straggling" under a wide variety of mean beam energies and initial beam energy distributions.

Publications

B.J. Kohn, "A Study of Proton Range 'Straggling' Due to Initial Beam Energy Distribution, AFWL-DYP-TN-78-113, June 1978

2. Determination of 14 MeV Neutron Fluences Using Copper Activation Foils and Gamma Coincidence Counting

Principal Investigator: Captain Robert Nuttelman, Department of Physics

Associate Investigator: CIC Barton H. Wohl

Absolute flux values of a neutron generator were determined using neutron activation of copper foils. The  $\text{Cu}^{63} (n, 2n) \text{Cu}^{62}$  reaction daughter product emits positrons which produce annihilation gammas. The absolute annihilation gamma activity was determined using a calibrated coincidence spectrometer to eliminate background radiation. The absolute neutron flux was then determined from the absolute gamma activity.

#### Presentation

Joint American Association of Physics Teachers, Colorado-Wyoming Academy of Science Meeting, Pueblo, Colorado, 21 April 1978.

#### 3. Soft X-Ray Emission from Coronal Loops

Principal Investigator: Captain Charles P. Catalano, Department of Physics

A study of X-Ray emission from coronal loops was carried out using the soft X-ray experiments aboard Mariner V and Explorer 35. Temperature and volume emissivity were determined from these data and an estimate of the altitude of the emission as well as the energy input with time were derived.

In addition it was noted for a particular series of events studied that, although coronal loops are usually associated with intense solar flares, the loops in these events were not energized by large solar flares although they could have been triggered by subflaring activity noted before the onset of the X-ray emission.

#### Presentations

"Soft X-Ray Emission from Post-Flare Coronal Loops," presented at the annual SPO, KPNO, LASL, HAO meeting, Santa Fe, NM on 6 October 1978.

#### 4. Chemical Structure/Bonding Decomposition Relationships and Chemiluminescent Gas Phase Relationships

Principal Investigators: Dr. John S. Wilkes and Captain Larry P. Davis, Frank J. Seiler Research Laboratory

Associate Investigator: Captain Henry L. Pugh, Jr., Department of Physics

These two programs apply the experimental tool of electron paramagnetic resonance (EPR) spectrometry to chemical processes in the gas and liquid phase. The decomposition relationships study began as a study of the thermal decomposition of TNT; but at the request of the Rocket Propulsion Laboratory the program now includes studies of similar processes in several solid rocket fuels. The radical kinetics for the TNT study have been determined using EPR methods, but the specific radical species which drive the reaction have not yet been identified. Further experiments to this purpose are in progress. The gas phase relationships study supports an Air Force Weapons Laboratory effort to develop efficient chemically excited lasers in the near uv region of operation. FJSRL workers constructed an oxygen reactor which reliably produces excited state oxygen concentrations sufficient to support successful lasing action of iodine. EPR methods were used to measure the oxygen concentrations, and further tests are continuing to fully characterize the reactor.

#### Papers

R.M. Guidry and L.P. Davis, "Thermochemical Decomposition of Explosives I. TNT Kinetic Parameters Determined from ESR Investigations," Thermochemica Acta, accepted for publication.

#### 5. Laser Isotope Separation - Economics and Applications

Principal Investigator: Captain Richard W. Davis, Department of Physics

Associate Investigators: Dr. Clyde Layne, Dr. Mike Schwab, and Mr. Stuart Winter

The new field of laser spectroscopy offers tremendous potential in the area of laser isotope separation and photochemistry. Using lasers to strip the tails of a uranium enrichment plant to provide fuel for light water reactors has the potential of saving billions of dollars per year and extending our uranium resources by over 20%. This research involves performing economic and component sensitivity analysis on various atomic vapor uranium laser isotope separation point designs. We are also identifying and evaluating applications that expand this technology to the fuels, beneficial products, waste disposal and structural materials of advanced reactors.

#### Presentations

Richard Davis, "Economic Evaluation and Sensitivity Analysis of an Atomic Vapor Laser Isotope Separation Process," presented to the Lawrence Livermore Laboratory LIS Staff, Livermore, on 22 June 1978.

#### Publications

Schwab, M, Davis, R, Winter, S, LIS Applications Study-Volume III, Advanced Reactors, UCRL-52194, Lawrence Livermore Laboratory. To be published.

## 6. Aircraft Engine Oil Analysis by Neutron Activation Techniques

Investigator: Captain Thomas A. Menard, Department of Physics

Sponsored by Air Force Materials Laboratory, Wright-Patterson AFB, OH

The Air Force currently conducts an oil testing program on all aircraft engines at specified intervals. The technique used is atomic emission spectroscopy and can detect 13 individual trace contaminants down to 1 PPM over a one minute test period. The objective of this research was to determine if neutron activation techniques could provide similar results at less cost. Californium-252 was used as a neutron source and tests were conducted on calibration samples prepared for the 13 elements of interests. Final results showed that neutron activation is not a cost effective replacement for atomic emission. Sensitivities for the 13 elements ranged from 21 PPM up to 11500 PPM with 2 hours required to analyze each sample. In order to achieve better results the required neutron fluxes would result in large expenditures for the source and facilities making them cost ineffective compared to current methods.

### Publication

"Aircraft Engine Oil Analysis by Neutron Activation Techniques," FJSRL Research Report.

## 7. Diurnal Variation of Total Electron Content of the Ionosphere

Principal Investigator: Captain John P. Cipriano, Department of Physics

Sponsored by the Air Force Geophysics Laboratory, Hanscom AFB, MA

The diurnal variability of ionospheric total electron content (TEC) is very important in predicting/analyzing the performance of a wide variety of radar, detection, and surveillance systems. This research involved using a computer model to generate expected diurnal variability of TEC, and then comparing these data with actual TEC data sets. The results indicate a general agreement between the two data sets, and AFGL has indicated that they would like to pursue this research with a second set of TEC data.

## 8. Optical Detection of Damage in Solids

Principal Investigator: Captain Wayne J. Anderson, Department of Physics

A previously derived technique of measuring radiation damage using reflectance measurements was used to monitor disorder dependencies for light and heavy ions as a function of flux and fluence. The results of the measurements are currently being used by the USAF Avionics Laboratory to design microwave devices for aircraft.

A computer model for laser windows and mirrors has been formulated to evaluate damage mechanisms and thresholds. An electron avalanche model was found to fit the limited data on damage thresholds. The computer model was used to design a laser mirror with a reflectivity of 99.95% and an order of magnitude higher damage threshold.

#### Publications

Wayne J. Anderson and Y. S. Park, "Flux and Fluence Dependence of Implantation Disorder in GaAs Substrates," *J Appl Phys* 49, August 1978, pp. 4568-4570.

#### 9. Analysis of Photometric Data on the Massive Eclipsing Binary Star V382 Cygni

Principal Investigator: Captain Raymond H. Bloomer, Jr., Department of Physics

Associate Investigators: Dr. Edward Burke, Department of Physics, King College, Bristol, Tennessee, and Dr. Robert Millis, Staff Astronomer, Lowell Observatory, Flagstaff, Arizona

The eclipsing binary star system V382 Cygni is one of thousands of known double star systems with short periods of revolution ( $P < 100$  days) which display light variations due to mutual eclipses. However, V382 is one of very few (a dozen or so) very hot "O-type" stars known to exist as eclipsing systems. In 1975 and 1976 the investigators obtained approximately 1400 data points in three standard wavelength windows on five different telescopes. During the past year all data has been transformed to an internationally recognized system of colors and loaded on a computer disk pack for analysis. A period study has also been completed which defines the period to be 1.8855143 days in basic agreement with past determinations; it appears that the period is not changing in a secular fashion. A complex computer code to analyze the data has been received and is now running on the USAFA Education and Research Computer. When thoroughly tested and modified to include hot stars like V382, the code will be used to derive the best possible light elements for the V382 Cygni system. The code, written by R. E. Wilson and E. J. Devinney, is one of the most comprehensive procedures available anywhere.

10. Design and Fabrication of a Current-Technology Flywheel-Electric Vehicle

Principal Investigator: Captain David D. Ratcliff, Department of Physics

Sponsored by Frank J. Seiler Research Laboratory

Current interest in vehicles operating by use of alternate fuels has renewed interest in electric vehicles. The electric vehicles available currently have limitations on range and acceleration which are imposed by the use of lead-acid batteries. Research into new batteries and high-technology flywheels promises to alleviate these limitations 5-10 years from now. The purpose of this research effort is to show--by prototype fabrication--that a low-technology flywheel-electric vehicle with improved range and acceleration can be built today with off-the-shelf parts.

During FY 78 the design was completed and construction was begun. By the end of the fiscal year, the framework for the body and most of the power train, including the flywheel, were completed. Completion of construction, testing and some follow-on efforts will occur during FY 79.

Presentation

D. D. Ratcliff, "The USAFA Flywheel-Electric Car," presented at the 49th meeting of the Colorado-Wyoming Academy of Science at the University of Southern Colorado in April 1978.

11. A Physics Model of a Runner for Possible Use in Athlete Training and Education at the United States Air Force Academy

Principal Investigator: Captain John P. Jackson, Department of Physics

Associate Investigator: Captain Jim Scott, Department of Physical Education, Research Division

A physics model of a runner has been constructed by Keller. This model, using only four parameters of maximum force, friction coefficient, total aerobic energy stored, and aerobic energy conversion rate, predicts world record times to within several percent over run distances varying in several orders of magnitude. Thus far, the basic equations have been thoroughly reviewed and simplified somewhat, and running data is nearly completed on approximately fifteen volunteer cadets and faculty officers. This data includes the 100 m, 400 m, 800 m, and 1 1/2 mile runs, the time of which will allow the calculation of the four basic parameters on each volunteer. It is anticipated and desired that an analysis of these parameters will suggest a useful method for monitoring, evaluation and characterizing cadet physical education on the Air Force Academy.

## II. GENERAL RESEARCH IN THE HUMANITIES AND SOCIAL SCIENCES

### A. Department of Behavioral Sciences and Leadership

#### 1. Pilot Performance with Peripheral Vision

Principal Investigator: Lt Colonel Jock C. H. Schwank, Department of Behavioral Sciences and Leadership

Associate Investigators: Majors John M. Bermudez and Valentin W. Tirman, Jr., Captains Dickie A. Harris, Bruce A. Smith, and Edwin B. Griggs, Department of Behavioral Sciences and Leadership and C1C Mark F. Godfrey

Sponsored by Aerospace Medical Research Laboratory/HEA, Wright-Patterson AFB

The purpose of this continuing study was to determine performances for pilot peripheral visual processing in the GAT-1 simulator and on a two-axis tracking task. The twenty-four cadet pilots in the GAT-1 were able to maintain heading as well with the peripheral lights, located at 55 degrees into the visual periphery, as they were with normal round dial instruments. The input of an additional workload stress did not reduce the effectiveness of the peripheral lights. The sixty cadet non-pilots on the two-axis task confirmed the results of the GAT-1 experiment, in that both experiments found a steady light located in the periphery was a more effective command indicator than a strobing peripheral light.

#### 2. The Effects of Job Enrichment and Goal Setting on Job Satisfaction and Organizational Effectiveness

Principal Investigator: Lt Colonel William E. Rosenbach, Department of Behavioral Sciences and Leadership

Associate Investigators: Lt Colonel Dennis Umstot, AFIT/SLGR, Major Valentin W. Tirman, Jr. and Captain William H. Clover, Department of Behavioral Sciences and Leadership

Sponsored by Air Force Office of Scientific Research

This longitudinal research which examines two major aspects of job redesign and goal setting--job satisfaction and productivity--was begun in March 1977. A remote nonequivalent control group design with multiple control groups and repeated measures is employed to test the research hypothesis.

The focal jobs are those of vehicle mechanics, vehicle operators, and transportation management specialists at two Air Force bases in the southeastern U.S. Interim results indicate that there has been a statistically significant increase in job satisfaction in the experimental group. Productivity results are positive but less conclusive. Final analysis will be completed during the coming year.

### 3. Stress Management Research

Principal Investigator: Captain Richard L. Hughes, Department of Behavioral Sciences and Leadership

Sponsored by the Frank J. Seiler Research Laboratory

Test anxiety is a situation-specific form of stress that affects as much as fifteen percent of college students. It leads to impaired performance on certain sorts of tasks and it is subjectively unpleasant. Various techniques have been used in treating test anxiety, but most are based on the assumption that reducing emotional arousal is the essential factor in treatment. Since biofeedback has been shown effective in reducing emotional arousal and enhancing relaxation, electromyographic biofeedback was evaluated as a treatment for test-anxious cadets. Biofeedback served as a relaxation-training technique which preceded a modified desensitization treatment. The treatment was evaluated in terms of physiological, self-report, and behavioral criteria. In general, biofeedback provided subjective relief from test anxiety but did not affect performance on academic tests. Furthermore, results suggested that test-anxious subjects may not be so physiologically aroused as they describe themselves as being. Thus, physiological-type treatments may not be so effective as would be more cognitively-oriented treatments.

### 4. Male and Female Anxiety During Survival, Evasion, Resistance and Escape (SERE) Training

Principal Investigator: Captain David C. Gillman, Department of Behavioral Sciences and Leadership

Associate Investigator: Captain Lee J. Dahle, Department of Behavioral Sciences and Leadership

Sponsored by the Frank J. Seiler Research Laboratory

A major data collection effort was undertaken during the summer of 1978. The entire class of 1981 (approximately 1500 cadets) were administered a battery of instruments before and after training to measure the effectiveness of SERE training. These tests included the Anxiety Scale (ASQ), the 8-State Anxiety Scale (8SQ), the Stressful Situations Scale (SSS), and some SERE specific items. The data is presently being analyzed.

### 5. Reacquisition and Maintenance of Flying Skills

Principal Investigator: Lt Colonel Jefferson M. Konce, Department of Behavioral Sciences and Leadership

Associate Investigator: Captain Larry L. Wheeler, Department of Behavioral Sciences and Leadership

Sponsored by the Air Force Office of Scientific Research

Approximately thirty-five subjects have flown the comprehensive flight profile in a T-40 (GAT III) flight simulator, and their performances were recorded in flight record booklets designed for this study. A computer program for evaluating each pilot's performance in comparison with norms based upon three hundred other missions has been developed. Data collection will continue for at least one more year to quantify the loss of both cognitive and psychomotor flying skills as a function of the length of time a pilot is assigned to non-flying duties.

### 6. Personal and Environmental Factors Contributing to BCT and Fourth Class Year Attrition

Principal Investigator: Captain Thomas M. Longridge, Department of Behavioral Sciences and Leadership

Associate Investigator: Major Valentin W. Tirman, Jr., Department of Behavioral Sciences and Leadership

Unsponsored

Based on recommendations contained in the 1976 General Accounting Office Report regarding Military Academy Attrition, a longitudinal study of attrition at the United States Air Force Academy was initiated. A locally devised Attrition Assessment Instrument (AAI) was validated and administered to the entire class of 1980 ( $N = 1572$ ). The instrument was designed to elucidate the causative factors associated with attrition during Basic Cadet Training and the 4th class year. Additionally, a second instrument, designed to assess the relative motivational value of each item in BCT curriculum, was developed and administered to the entire class at the end of BCT.

In general it was concluded that attrition during Basic Cadet Training was largely a function of personal characteristics of the individual rather than demotivational aspects of training. Reduction in BCT attrition may therefore be a matter of improved candidate selection procedures.

Attrition beyond BCT is less influenced by personal characteristics but is more influenced by the Academy environment experienced in the 4th class year. Suggestions on improvement in the environment are provided and deal with training goals, upperclass leadership style, feedback, and length of the 4th class training year.

7. Similarities of Men and Women in Perceptions of Their Work and Their Affective Responses: An Empirical Test

Principal Investigator: Lt Colonel William E. Rosenbach, Department of Behavioral Sciences and Leadership

Associate Investigator: Major Valentin W. Tirman, Jr., Department of Behavioral Sciences and Leadership

Sponsored by Hq USAF

Female and male workers described characteristics of their job as well as their satisfaction with the job itself and related aspects. As expected, the men and women did not differ in their perceptions of their work or their affective responses to it. The only significant difference between the two groups was their satisfaction with pay.

A growing number of studies have empirically demonstrated that supposed sex differences in personality, abilities, and attitudes about work are not valid (Lirtzman and Wahba, 1973; Reif, Newstrom, and Monczka, 1975). Decisions made about women on the sole basis to their sex, without considering individual and demographic characteristics such as background, education, experience, personality, and potential are likely to be in error. The major objective of this research was to explore the alleged differences between men and women with respect to their attitudes about their jobs and their affective responses to work.

8. Analysis of Soviet Behavioral Sciences

Principal Investigator: Major Valentin W. Tirman, Jr., Department of Behavioral Sciences and Leadership

Associate Investigator: Lt Colonel Eugene H. Galluscio, Department of Behavioral Sciences and Leadership

Sponsored by the Defense Intelligence Agency

This is a continuing project for the evaluation of the Soviet "state of the art" in various areas of the behavioral sciences, to include psychopharmacology, individual and group behavior modification, and parapsychology.

9. Analysis of Information Sources Within the Air Force

Principal Investigator: Major Ronald LaScala, Department of Behavioral Sciences and Leadership

Associate Investigators: Major B. D. Sullivan (USA) and Captain Thomas J. Twardowski, Department of Behavioral Sciences and Leadership

Sponsored by Air Force Office of Scientific Research

This study is to develop a technology to evaluate the effectiveness of the current information sources available within the Air Force. An initial survey instrument has been developed, validated at the Academy, and revalidated at Williams and Luke AFBs. The finalized instrument has been developed and is in the process of coordination at Air Staff. Upon approval, the survey instrument will be administered in all major commands at selected bases in the CONUS.

#### Publications

Bermudez, J.M., Schwank, J.C.H., Longridge, T.M., Smith, B.A., and McCloy, T.M. Effect of peripherally presented visual signals on pilot performance during flight simulation. Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory, Technical Report, In Press.

Godfrey, M.F., Smith, B.A., and Schwank, J.C.H. Visual processing: The effects of peripheral heading cues in flight. U.S. Air Force Academy, CO: Proceedings of the Psychology in the DOD Symposium. 1978.

Tirman, V.W., Jr. and Galluscio, E.H. Soviet Psychology (U). Washington, D.C.: Defense Intelligence Agency, Technical Report DST-1810S-388-78, May 1978.

#### Presentations

Godfrey, M.F. Visual processing: The effects of peripheral heading cues in flight. Psychology in the DOD Symposium, U.S. Air Force Academy, CO, 1978.

Schwank, J.C.H. Using peripheral cues in flight. Colorado Springs Society of Military Optometrists, Colorado Springs, CO 1978.

Rosenbach, W.E. Job enrichment in the military service. Inter-Service Human Resources Management Conference, Maxwell AFB, AL, October 1977.

Rosenbach, W.E. Work redesign in the public sector. 38th Annual Meeting of the Academy of Management, San Francisco, CA, August 1978.

Rosenbach, W.E. Military organizational development and effectiveness program. 86th Annual Meeting of the American Psychological Association, Toronto, Canada, August 1978.

Berger, Robert & Hughes, Richard L. Biofeedback treatment of test anxiety. Presented to El Paso County Psychological Association, March 1978.

Hughes, Richard L. A comparison of three treatments of test anxiety. Presented to the Sixth Psychology in the DOD Symposium, U.S. Air Force Academy, CO, April 1978.

Longridge, Thomas M. and Tirman, Valentin W. "Personal and Environmental Factors Contributing to BCT and Fourth Class Year Attrition," presented at our 20-22 April 1978 Sixth Symposium sponsored by USAF Academy.

Rosenbach, William E. and Tirman, Valentin W. "Similarities of Men and Women in Perceptions of Their Work and Their Affective Responses: An Empirical Test," presented at USAF Academy Sixth Symposium on Psychology in the DoD, 20-22 April 1978.

B. Department of Economics, Geography and Management

1. Preferential Tariff Reductions: The Philippine Response, 1900-1940

Principal Investigator: Colonel L. D. Badgett, Department of Economics, Geography and Management

Preferential tariff reductions have been recommended as a means of stimulating industrialization in less-developed countries. This article investigates the history of one particular preference relation to determine the answers to three questions which are fundamental to the current policy debate. Specifically, in the case examined: (1) was there a systematic relation between the degree of preference granted and the grantee's commodity structure of production and exports; (2) was the magnitude of the subsidy provided by preference economically significant; and (3) did the subsidy provided by preference induce an economically significant increase in the grantee's industrial processing activity? The results may be summarized as follows: for each sector, the preference relation was a statistically significant determinant of the processing ratio; the preference subsidy provided an important contribution to total revenue for each sector; and, finally, the preference received by three sectors alone induced a significant expansion in total Philippine processing activity.

Publication

Journal of International Economics, 1978.

2. The Rent-Buy Decision for Military Families

Principal Investigator: Captain Stephen H. Russell, Department of Economics, Geography and Management

This report compares and contrasts the property appreciation and income tax savings advantages of home ownership to the cash-flow advantage of occupying government quarters. An algorithm is developed for service

members to use in objectively measuring and comparing the financial advantages of each option. The popular notion that the "buy" decision is always best from a financial standpoint is brought into question.

Publication

USAFA-TR-77-8, USAF Academy Technical Report, July 1977.

3. The Utilization of Side-Looking Airborne Radar (SLAR) in the Analysis of Karst Topography

Principal Investigator: Major Charles L. Smith, Department of Economics, Geography and Management

Associate Investigator: Major A. Paul Tribble, Department of Economics, Geography and Management

Characteristics of mechanical and synthetic radar systems are reviewed. Signature elements of karst topography such as a vertical drainage pattern, knobs, and sinkholes are identified for Side-Looking Airborne Radar (SLAR) imagery. SLAR imagery of the Kentucky Pennyroyal and karst areas in Florida is presented with the signature elements highlighted. Applications of SLAR imagery to the identification and mapping of karst areas in physically, climatologically, or politically inaccessible areas are addressed.

Publication

USAFA-TR-77-13, USAF Academy Technical Report, September 1977.

Presentation

National Convention, Association of American Geographers, New Orleans, Louisiana, April 1978.

4. Change After an Earthquake Disaster in Western Anatolia

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Associate Investigator: Captain C. Taylor Barnes, Department of Economics, Geography and Management

Planned development has led to relatively rapid changes in rural Turkey. Based on field research in Turkey, this report examines and describes some of the changes which occurred when an unplanned

disruptive natural force confronted a rural area of a developing country. Detailed relative change over a three-year period between a village damaged by the 1970 Gediz earthquake and an undamaged village in the same region is analyzed, followed by an interpretation of surrogates of change from a group of thirty-four earthquake damaged villages and thirteen undamaged "control" villages.

Publication

USAFA-TR-78-5, USAF Academy Technical Report, January 1978.

5. Analysis of Crime in Manitou Springs, Colorado (1976-June 1977)

Principal Investigator: Major A. Paul Tribble, Department of Economics, Geography and Management

Associate Investigator: Major Charles L. Smith, Department of Economics, Geography and Management

This report is concerned with the characteristics of crimes, victims, and criminals for Part I (felonies) and Part II (misdemeanors) crimes committed in Manitou Springs, Colorado, between 1 January 1976 and 30 June 1977. Further, a section is included on the geographic aspects of crime in Manitou Springs. Included in this section is an analysis of the residences of criminals by places of occurrence of their crimes, military involvement in crimes, and the distribution of various types of felony crimes.

Publication

USAFA-TN-78-1, USAF Academy Technical Note, January 1978.

6. Energy Atlas of Montana

Principal Investigators: Major Charles L. Smith, Captain John G. Christenson, and TSgt John R. Wagner, Department of Economics, Geography and Management

Presents the locational aspects of the energy resources available in Montana. Resources include coal, oil and gas, uranium, oil shale, and water. The location of power plants and power transmission lines are also indicated as are those for water resources.

Publication

USAFA-TN-78-3, USAF Academy Technical Note, March 1978.

7. Energy Atlas of Utah

Principal Investigators: Major Charles L. Smith, Captain John G. Christenson, and TSgt John R. Wagner, Department of Economics, Geography and Management

Presents the locational aspects of the energy resources available in Utah. Resources include coal, oil and gas, uranium, oil shale, and water. The location of power plants and power transmission lines are also indicated as are those for water resources.

Publication

USAFA-TN-78-4, USAF Academy Technical Note, March 1978.

8. Energy Atlas of Wyoming

Principal Investigators: Major Charles L. Smith, Captain John G. Christenson, and TSgt John R. Wagner, Department of Economics, Geography and Management

Presents the locational aspects of energy resources available in Wyoming. Resources include coal, oil and gas, uranium, oil shale, and water. The location of power plants and power transmission lines are also indicated as are those for water resources.

Publication

USAFA-TN-78-5, USAF Academy Technical Note, March 1978.

9. Energy Atlas of Colorado

Principal Investigators: Major Charles L. Smith, Captain John G. Christenson, Captain John R. Taylor, and TSgt John R. Wagner, Department of Economics, Geography and Management

Presents the locational aspects of the energy resources available in Colorado. Resources include coal, oil and gas, uranium, oil shale and water. The location of power plants and power transmission lines are also indicated as those for water resources.

Publication

USAFA-TR-77-15, USAF Academy Technical Report, September 1977.

.0.

10. Climate, Soils and Vegetation of the Rampart Range, Colorado

Principal Investigator: Major Charles L. Smith, Department of Economics, Geography and Management

This report reviews the climate, soils and vegetation of a segment of the Colorado Front Range and adjacent Colorado Piedmont. Variations in temperatures, precipitation, evaporation, and wind are analyzed as are the soil associations. The grassland biome, scrub biome, and coniferous forest biome and their distribution are also described.

Publication

USAFA-TR-77-18, USAF Academy Technical Report, December 1977.

11. Natural and Man-Induced Soil Pollution

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Associate Investigator: Sue H. Raabe, Department of Geology, University of Colorado at Colorado Springs

Soil pollution is a form of pollution that is not as readily apparent as that found in air and water but can be just as noxious. Soil pollution should be considered in any efforts to ameliorate the misuse of the environment. This report examines various forms of both naturally and humanly induced soil pollution.

Publication

USAFA-TR-77-19, USAF Academy Technical Report, November 1977.

12. Future Patient Demand in the USAF Academy, Colorado Hospital Catchment Area

Principal Investigator: Major A. Paul Tribble, Department of Economics, Geography and Management

Associate Investigator: Major William A. Mitchell and Captain C. Taylor Barnes, Department of Economics, Geography and Management

In 1977, the USAFA Hospital Commander was informed that OB/GYN services could be curtailed at the Fort Carson Hospital in 1978. Because of the proximity locations of the Academy and Fort Carson Hospitals, the former could be expected to absorb a portion of the workload of the latter

if such a curtailment occurred. The present study assesses the potential impact on the USAFA Hospital in the event of the curtailment. The conclusions are: (1) The greatest relative impact on OB/GYN care would be felt during July, August, and December of each year; (2) If patients from the Fort Carson Hospital were to use the USAFA Hospital in the numbers indicated in a Fort Carson Hospital patient survey, the upper levels of supply at the USAFA Hospital for all categories of OB/GYN care would be surpassed. Further, the present study examines the demographic characteristics of the USAFA and Fort Carson Hospital Catchment Areas, and projects future patient demand by age, sex, and acute condition through 1985 for each facility.

Publication

USAFA-TN-78-6, USAF Academy Technical Note, April 1978.

13. Avalanche and Non-Avalanche Talus Slope Comparison Colorado Front Range

Principal Investigator: Captain Thomas P. Huber, Department of Economics, Geography and Management

Comparison of three talus slopes in the Front Range of the Rocky Mountains in Colorado shows differences in their formative processes. Avalanche, rockfall, alluvial, and mudflow processes appear in differing proportions on the slope. Development of slope profiles helps differentiate between slope-forming factors. Regression equations show relationships between downslope distance and boulder size and between down-slope distance and slope angle. Analysis of soil samples determines percentages of sand, silt, and clay. Finally, qualitative factors prove invaluable in confirming the presence of specific slope-forming processes.

Publication

USAFA-TR-77-14, USAF Academy Technical Report, October 1977.

14. Preparation of Maps for Use by the FEA

Principal Investigator: Major Charles L. Smith, Department of Economics, Geography and Management

Presentation

Regional Meeting of the Association of American Geographers, September 1977.

15. Predicting Casualties and Damages Caused by Earthquakes in Turkey

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Associate Investigators: Major Richard Wolniewicz, Department of Economics, Geography and Management and John F. Kolars, Department of Geography, University of Michigan, Ann Arbor, Michigan

Inaccurate information about the dimensions of an earthquake disaster can result in further casualties and add to the trauma of an already complex human adjustment problem. Governments in disaster-prone countries need a mechanism by which casualties and damages can be estimated almost immediately after the destructive event. Mismanagement of the disaster can be minimized with accurate information. This research was designed to provide a model for use by Turkish and American authorities in responding to earthquake disasters. Specifically, the objective was to construct a model which would estimate the casualties and damages minutes after an earthquake in Turkey. The model was to determine and verify the need for international and United States government relief efforts. Dependent variables were "deaths" and "damages." Independent variables were magnitude, epicentral location, population density, number of people within 25 miles of an epicenter, and location. A three part model is suggested, which, after refinement with more data, could be used to predict houses destroyed. Further research on micro-zonation of geological foundations is essential.

Publication

USAFA-TN-78-2, USAF Academy Technical Note, March 1978.

Presentation

The Government of Turkey, Earthquake Research Institute, Ankara, Turkey, June 1978.

16. A Model for Public Education on Earthquake Hazard Minimization

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Presentation

National Council on Geographic Education, St. Louis, Missouri, November 1977.

17. Perspectives on Turkey

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Presentation

Geographic Division of the Central Intelligence Agency, Washington, D.C., September 1978.

18. Construction in Seismic Zones: A Model for Users and Planners

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Presentation

Geographical Institute, University of Istanbul, Turkey, July 1977.

19. Seven Years After Disaster: Old and New Gediz in Light of Kates' and Pijawka's Model

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Presentation

Annual Association of American Geographers, New Orleans, Louisiana, April 1978.

20. Decision Making and Natural Disasters

Principal Investigators: Major William A. Mitchell and Captain C. Taylor Barnes, Department of Economics, Geography and Management

Presentation

National Council on Geographic Education, St. Louis, Missouri, November 1977.

21. Harmonic Analysis of Precipitation in Turkey

Principal Investigator: Major William A. Mitchell, Department of Economics, Geography and Management

Associate Investigator: CIC Al Randall, USAFA

Presentation

20th Annual Conference, Western Regional Social Science Association, Denver, Colorado, April 27-29, 1978.

22. Hello, Is Anyone Out There?

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Credit Women International, February 1978.

23. Performance Appraisal, Assertiveness Training, Personal Awareness, Management Styles

Principal Investigator: Captain Robert E. Pizzi, Department of Economics, Geography and Management

Presentation

Medical Food Service Management for Dieticians Course and Physiological Training Officers Course, 5-9 June 1978.

24. Management by Objectives

Principal Investigator: Captain Robert E. Pizzi, Department of Economics, Geography and Management

Presentation

Colorado Fiscal Managers Association, 24 March 1978.

25. Preparing a Budget for Equal Opportunity Programs

Principal Investigator: Captain Robert E. Pizzi, Department of Economics, Geography and Management

Presentation

Federally Employed Women Inc., 1978 National Training Conference, 14-15 July 1978.

26. Communication and Motivation: Your Most Important Tools

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Littleton Educational Secretaries Association, August 1977, and the National Training Conference of the Federally Employed Women, Inc., Denver, Colorado, July 1978.

27. Time Management

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

AUIPD/PPM, August 1977.

28. The USAFA Management Curriculum

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

USAF Precommissioning Leadership and Management Education Workshop, Maxwell AFB, Alabama, 25-27 April 1978.

29. Communication Workshop

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Colorado Springs Department of Public Utilities, May 1978.

30. You, Your Job, and Your Future

Principal Investigator: Lt Col Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Workshop for USAFA secretaries, July 1978.

31. Sergeants Administrative Workshop

11

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Utah Peace Officer Standards and Training, Salt Lake City, 26-27 May 1978.

32. Giants in Management: Jim Webb of NASA

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Management History Division, 38th Annual Meeting of the Academy of Management, San Francisco, 9-13 August 1978.

33. Organization Climate

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

Colorado Springs Department of Public Utilities, June-July 1978.

34. First-Line Management--Police Sergeant's Administrative Workshop

Principal Investigators: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management and Major Gerald L. Jones, RRE

Presentation

Utah Peace Officer Standards and Training, Salt Lake City, 19-20 September 1978.

35. How Am I Doing, Boss?

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

The National Secretaries Association, Pikes Peak Chapter, Colorado Springs, 12 September 1978.

36. The USAFA Management Curriculum

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

### Presentation

2nd Annual Senior Service College Management Symposium, Ft. McNair, 19-21 July 1978.

#### 37. Collaborative Goal Setting in Performance Appraisal: A Field Experiment

Principal Investigators: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management and Dr. Robert A. Zawacki, University of Colorado at Colorado Springs

An organization's performance appraisal and development system (PADS) was changed to measure the effects of collaborative goal setting. Subjects were divided into experimental and control groups. Pretest and posttest measures revealed significant differences in perceived involvement, feedback, and attitudes between groups with the experimental group feeling more involved, more satisfied with the PADS, and receiving more positive feedback.

### Publication

Public Personnel Management 7:3, May-June 1978, pp. 162-170.

#### C. Department of English

##### 1. Glossary of Poetic Terms

Principal Investigator: Captain Thomas P. Coakley, Department of English

Sponsored by individual and Department of English

A glossary of approximately one hundred terms/devices used in discussing contemporary poetry with examples from 20th Century American and British poetry.

### Publication/Presentation

Currently being used in author's English 495 course and currently being revised for future publication.

##### 2. The Good Old Days?: Joel Chandler Harris and Charles W. Chesnutt

Principal Investigator: Captain Bruce J. Degi, Department of English

Sponsored by individual

Joel Chandler Harris, of course, is the author of the "Uncle Remus" stories. Charles Chesnutt, a Black author, borrowed the Uncle Remus concept and turned out his own plantation stories in the 1870's. Both were highly successful at first. Both, however, lost readership rather quickly. Harris, pandering to the nation's thirst for pleasant stories about the "Good Old Days" was able to regain public interest. Chesnutt, increasingly interested in the problems of the present condition of the Black in America (turn of the century), dropped entirely from view. The article will deal with this cycle evident in American Library magazines of the last century.

3. John Burgoyne's "Lord of the Manor" and the Beginnings of English Musical Comedy

Principal Investigator: Major James C. Gaston, Department of English

Sponsored by individual

This analysis of Burgoyne's comic opera describes it as a transitional step between the ballad operas of the early eighteenth century and the musical comedies of the early nineteenth century.

Publication/Presentation

For possible presentation at the Annual Conference of the South Central Society for Eighteenth-Century Studies in March 1979.

4. Cleanth Brooks at USAFA

Principal Investigators: Major James A. Grimshaw, Jr., and Major Paul D. Knoke, Department of English

Sponsored by USAF Academy

An edited transcript of Brooks' lectures/remarks made to cadets during his Spring '78 visit.

5. "Brother to Dragons": A Discussion

Principal Investigator: Major James A. Grimshaw, Jr., Department of English

Sponsored by individual

A book-length collection of essays with an explanatory introduction about Warren's verse drama.

Publication/Presentation

Under consideration at Random House.

6. Flannery O'Connor: A Companion

Principal Investigator: Major James A. Grimshaw, Jr., Department of English

Sponsored by individual

A book-length introduction to the fiction of Flannery O'Connor, including catalogue of her characters. Illustrated.

Publication/Presentation

Greenwood Press.

7. Wild Bill Shakespeare Rides Again

Principal Investigator: 1Lt Fannalou Guggisberg

Sponsored by individual

Originally sub-titled "Lear West of the Pecos," this article is a parody of Shakespeare's tragedy, King Lear, using western lingo to retell the story in prose, retaining the five acts as five separate actions and retaining the tragic ending, although introducing tongue-in-cheek commentary.

Publication/Presentation

Sent to Far West Magazine. Presently under consideration.

8. Orphans of the Storm: Running a College-level Theatre Program Without a Theatre Major or Theatre Department

Principal Investigator: Captain Raymond C. Harlan, Department of English

Sponsored by individual

A panel discussion led by Captain Harlan. Panel will consist of 3-5 members each of whom will read a brief informal paper and field questions from the audience. Possible sub-topics include staffing, curriculum, goals, etc., of a theatre program.

Publication/Presentation

Accepted as a program at the Rocky Mountain Theatre Conference Convention, 24-27 Jan 79. Proposal also being considered by American Theatre Association Convention in August 1979.

9. The Paperwork Air Force: Adapting Air Force Writing to Air Force Needs

Principal Investigator: Major William E. McCarron, Department of English

Sponsored by individual

Shows how the same written message on a technical subject can be adapted to different audiences within DoD. Example used is the F-16 fire control navigation panel.

Publication/Presentation

Submitted to HQ AFROTC's Education Journal.

10. Human Nature and Four Humorists of the Old Southwest: Hooper Lewis, Warren, and Harris

Principal Investigator: Captain Jennings R. Mace, Department of English

Sponsored by individual and USAF Academy

Through a close study of the four humorists above, the author's doctoral dissertation attempts to trace the changing view of human nature found in those humorists. Their rather clear-eyed portraits of man, complete with diseases, flaws, and lusts, places them at odds with the prevailing Romanticism of their time (1835-1867).

Publication/Presentation

Author hopes to defend the dissertation in March 1979 at the University of North Carolina.

11. Henry Clay Lewis (a biographical entry)

Principal Investigator: Captain Jennings R. Mace, Department of English

Sponsored by individual and Dictionary of Literary Biography: The American Renaissance in New York and the South

DLB is a multi-volume series designed to fill a fifty-year gap in American biographical scholarship. This particular entry--Henry Clay Lewis--is a brief sketch of Lewis' life and his current critical reputation.

Publication/Presentation

Gale Research Company Book Tower, Detroit, Michigan 48226. Publication is set for mid-1979.

12. Black Literature and the Military Mind

Principal Investigator: Captain Curtis Martin, Department of English

Sponsored by individual and National Council of Teachers of English

This study will focus on:

- (a) current indications of racial problems in the U.S.;
- (b) analysis of differences in perspectives of white students vs black students (cadets) and its effect on the Black Literature classroom, and
- (c) implications of the above data on future Black Literature courses.

Publication/Presentation

To be presented as a talking paper at NCTE National Convention in Kansas City, Missouri, late November, 1978.

13. Air Force Effective Writing Course

Principal Investigator: Major Thomas A. Murawski, Department of English

Sponsored by HQ USAF

Three 10-minute films that set Air Force writing standards. Part 1: Organizing Your Ideas; Part 2: Speaking on Paper; Part 3: Solving Special Problems.

Publication/Presentation

Due out mid-1979. Each base will keep copies for periodic showing.

14. The Air Mail Emergency of 1934: The Heisenberg Principle Exemplified in Journalism

Principal Investigator: Captain James S. O'Rourke, Department of English

Sponsored by individual

A 3,500-word article dealing with U.S. journalistic treatment of the 1934 Air Mail Emergency during which the U.S. Army Air Corps was directed by President Roosevelt to fly the mail. Journalistic and reportorial objectivity comes in conflict with the public interest. The San Francisco Chronicle and its editorial policies are examined in detail.

Publication/Presentation

Now under consideration by Journalism History, University of California at Northridge.

15. The Introduction of Televised Instructional Material into the USAF Air Command & Staff College Non-Resident Curriculum: An Experimental Comparison with Existing Methods

Principal Investigator: Captain James S. O'Rourke, Department of English

Sponsored by individual

The educational impact of instructional material contained on video cassettes is compared with the impact of materials presented in a traditional mode (print); unique characteristics of the television medium are examined across a wide range of educational objectives for USAF majors in non-residential, seminar settings. Measurement will be accomplished by a series of controlled, written examinations in three control and three experimental groups. A simple student's t-test will be applied to examination results to analyze between-group and within-group variance.

Publication/Presentation

This study is being conducted in partial satisfaction of the requirements for the degree of Doctor of Philosophy, S. I. Newhouse School of Public Communication, Syracuse University (N.Y.).

16. Book Review of "Scott of the Antarctic" by Elspeth Huxley

Principal Investigator: Captain James S. O'Rourke, Department of English

Sponsored by individual

A review of Huxley's new volume about Robert Falcon Scott of the Royal Navy and his expeditions to Antarctica, 1901-04 and 1910-12.

Publication/Presentation

Under consideration by The Air University Review (AU), Maxwell AFB, Alabama.

17. Donne and the Herbert Family

Principal Investigator: Colonel J. M. Shuttleworth, Department of English

Sponsored by individual

This study explores the relationship and influence between John Donne and the family of Lady Magdalene Herbert. Previous studies have ignored the extensive ties between them and have attributed influence on Donne only to George Herbert.

18. Come Down Out of Your Ivory Tower, Professor: The English Department and the World Outside

Principal Investigator: Colonel J. M. Shuttleworth, Department of English

Sponsored by individual

This essay advocates active involvement of English faculties in the business, academic, and professional worlds around them. It urges participation in institutional governing bodies and active management of resumes.

Publication/Presentation

To be published in the ADE Bulletin.

19. Herman Melville and the Art of Leadership

Principal Investigator: Major V. L. Thacker, Department of English

Sponsored by individual and USAF Academy

2. This doctoral dissertation is a study of Melville's depiction of leaders and his attitudes towards leadership. His interest in the good leader (or lack of one) reflects a political conservatism that exists throughout his entire career.

Publication/Presentation

This dissertation should be complete by May 1979.

## 20. Technical Writing and Television

Principal Investigator: Major Bill Wallisch, Department of English

Sponsored by individual and International Technical Communications Conference (ITCC)

A paper to be delivered to the above conference. A "how to" paper on using television in the tech writing classroom. Tells about author's tech writing tapes as well as "The Blue Tube."

### Publication/Presentation

Will be presented to the ITCC in Los Angeles, CA, on 16 May 1979.

## 21. Competitive Speechmaking

Principal Investigators: Major David C. Whitlock, Major Donald E. Ahern, Captain Leo Finkelstein, Jr., and Captain Charles E. Miller

Sponsored by individuals

This work prepares undergraduate college students for intercollegiate speech competition. Centering on a practical approach, the book demonstrably guides student speakers through every stage of preparation. Its instruction is especially useful to students planning to compete in after-dinner speaking, communication analysis (rhetorical criticism), extemporaneous speaking, impromptu speaking, informative-expository speaking, interpretation, and oratory-persuasion.

### Publication/Presentation

1980.

## D. Department of Foreign Languages

### 1. The Cloze Test as a Procedure for Establishing Objective German Prose Readability Standards

Principal Investigator: Major Brent M. Strong, Department of Foreign Languages

Sponsored by the USAF Academy

Research on utilizing a very straight forward testing technique, the Cloze procedure, to assist teachers of German in more objectively and rationally choosing reading selections of the appropriate difficulty level for college-aged students of German. By applying the statistical technique of

polynomial regression analysis on data collected from over 200 students of German enrolled in 27 different German classes, this work identifies that Cloze percentage score at which non-native readers of German begin to glean measurable factual information as a result of reading.

2. Computer Management of Foreign Language Grading and Test Analysis at the Air Force Academy

Principal Investigator: Captain Richard R. Lefebvre, Department of Foreign Languages

Sponsored by the USAF Academy

The grading process in the Department of Foreign Languages involves evaluation of student learning in several skill areas not generally evaluated in other academic disciplines. Consequently, research is being conducted in the computer management of student progress evaluation data. The prime function of this system is to manage student instruction and progress through an automated data base. Quizzes and graded reviews are generated and scored by the system with outputs including diagnostic reports for use by students as well as instructors. Course and student evaluations are accomplished by the production of major exam analysis reports.

Also being researched is the feasibility of computer-assisted instruction (CAI). CAI would be used to enhance the current teaching methodology in DFF. Through the computer's performance analysis and decision-making characteristics, students will be able to review grammar and increase their reading comprehension.

3. Study Packets to Accompany the Soviet Language Text, Russian for Everybody

Principal Investigator: Major Daniel G. M. Hannaway, Department of Foreign Languages

Sponsored by the USAF Academy

A series of 40 study packets used in the basic and intermediate Russian language courses at USAFA to enhance student learning. Each packet contains detailed lesson objectives, assignments, grammar explanations, taped exercises guides, cultural readings, written exercises, cartoons, etc. The packets are designed to insure that each student achieves maximum learning in every lesson by incorporating elements of self pacing with immediate feedback and by stimulating the student's interest in the cultural as well as the linguistic aspects of the courses.

12.

4. Soviet Thoughts on Military Leadership

Principal Investigator: Major Daniel G. M. Hannaway, Department of Foreign Languages

Sponsored by individual

A paper which examines what high-ranking officers in the USSR hold to be the most important qualities a military leader can possess. The study centers on the six general requirements for effective leadership which were set forth by the late Marshal A. A. Grechko in his book The Armed Forces of the Soviet State (1975).

E. Department of History

1. A History of the United States Air Force

Principal Investigator: Colonel Alfred F. Hurley, Department of History

Sponsored by the USAF Academy and the John S. Guggenheim Foundation

Research and writing on the development of the Air Force as an institution with emphasis on its origins from 1890 to 1947. Makes use of primary sources among records of the Air Force and its predecessors, Air Force Archives at Maxwell AFB, National Archives in Washington, D.C., and papers of such founders as Foulois, Mitchell, Spaatz, and Arnold. Results to be published in a book by Macmillan Company for its series on Wars and Military Institutions of the United States.

2. USAFA Oral History Program

Principal Investigator: Captain Phillip S. Meilinger, Department of History

Sponsored by the USAF Academy

The Oral History program conducted several taped interviews which were typed into manuscripts. The manuscripts will serve as "original source" historical documents and will be deposited in the Special Collections Division of the USAF Academy Library; Butler Library, Columbia University; and the USAF Historical Research Division, Maxwell AFB, Alabama.

The interviews covered a total of some seventeen hours and were all related to aviation, the Air Force, or U.S. Air Force Academy history.

The following interviews were conducted this year: Mr. Paul Garber on early aviation and the Wright Brothers; Col Anthony V. Grossetta, USAF (Ret), on his experiences as a fighter pilot during World War II; Col Frank Merritt, USAF (Ret), on his experiences during the Korean War; Mr. Ben Martin on his tenure as Head Football coach at the Academy; Lt Gen Albert P. Clark, USAF (Ret), on his tenure as Superintendent of the Academy; General Earle E. Partridge, USAF (Ret), on his experiences as Far East Air Forces Commander during

the Korean War; Mrs. Gail McComas on her duties as the first Cadet Wing Hostess of the Academy; Col Perry Dahl, USAF (Ret), on his experiences as an ace and fighter pilot during World War II; and Col John M. Williams, USAF (Ret), on his experiences as one of the original Flying Tigers during World War II.

3. The Harmon Memorial Lectures in Military History

Principal Investigator: Captain Phillip S. Meilinger, Department of History

Sponsored by the USAF Academy and the Association of Graduates

The first twenty annual lectures in the Harmon Memorial Lecture Series have been published separately. Plans call for publication in the future of a volume containing all lectures presented to the date of publication.

4. Chinese Perspectives in Selected Western Literature, 1915-1930

Principal Investigator: Captain Charles L. Aldrich, Department of History

Sponsored by the National Endowment for the Humanities

This paper examines the manner in which China was portrayed to Western observers through the works of selected authors. The writings of such literary figures as Bertrand Russell, John Dewey, J.O.P. Bland, Harley MacNair, and Henry Norton were studied in an effort to understand how public opinion about China was shaped during the years 1915-1930. The paper was prepared in conjunction with the National Endowment for the Humanities Summer Seminar, "Perspectives in Chinese History," conducted at the University of Chicago, June-July 1978.

5. Yeoman Regions in the Antebellum Deep South: Settlement and Economy in Northern Alabama, 1815-1860

Principal Investigator: Major John Allman, Department of History

Sponsored by USAF Academy

Analysis of the settlement and space economy of the deep South in terms of sociological and economic theories applicable to developing nations today.

6. American Military Missions to Korea: 1882-1896

Principal Investigator: Captain Donald M. Bishop, Department of History

Sponsored by USAF Academy

Analysis of the role of American military and naval officers in the period which followed the opening of Korea by Commodore Shufeldt in 1882. The investigation emphasizes the modernization impact of the American missions on the political order of the late Yi dynasty and the failure of the Korean armed forces to reform.

Two phases of this research have been published. See "Navy Blue in Old Korea," Journal of Social Sciences and Humanities (Seoul), No 42 (December 1975), pp. 49-63, and "Policy and Personality in Early Korean-American Relations: The Case of George Clayton Foulk," in The United States and Korea, Andrew C. Nahm, ed. (Kalamazoo: Western Michigan University, forthcoming). A final article, "A Premature Vanguard: The American Military Mission to Korea, 1888-1896," is now ready for submission to a journal.

#### 7. Korean Immigration to the United States

Principal Investigator: Captain Donald M. Bishop, Department of History

Sponsored by USAF Academy

Since the liberalization of the immigration laws in 1965, Koreans have become one of the largest groups of new immigrants. This study concentrates on their numerous problems in adjusting to American culture.

A series of articles on the Korean immigration was prepared for The Korea Times, and a special publication to assist Catholic immigrants in their worship was prepared under the auspices of USAFA (HCC). The latter publication, a Korean-English missalette, was entitled An Immigrant's Mass for English-Speaking Priest and Korean Congregation, Donald M. Bishop, Jemma W. Bishop, and Chaplain Edward J. Kucera, eds. (USAFA Community Center Chapel, 1978).

#### 8. American Forces in Foreign Cultures

Principal Investigator: Captain Donald M. Bishop, Department of History

Sponsored by USAF Academy

The investigation examines the impact of American military forces in overseas garrisons on host nations and the factors which influence the behavior of American servicemen overseas--culture shock, ethnocentrism, ignorance, prejudice, and family separation.

One publication has resulted: "American Forces in Foreign Cultures,"  
US Naval Institute Proceedings, April 1978, pp. 42-50.

9. Air Force Atomic Capability from V-J Day to the Berlin Blockade--Potential or Real?

Principal Investigator: Major Harry R. Borowski, Department of History

Sponsored by USAF Academy

This research evolved from a PhD dissertation tracing the development and analyzing the atomic capability of Strategic Air Command between 1946 and the Korean War. A paper resulting from the research was presented at the 1978 meeting of the Missouri Valley History Conference.

10. Strategic Thought to 1945

Principal Investigator: Colonel Philip D. Caine, Department of History

Sponsored by The National War College

Research project involved the development of a course syllabus for the National War College for the fall semesters, 1977-1978. The course dealt with strategic thought from ancient Greece through World War II. The focus was on strategy as it was developed by the great thinkers and reflected in the evaluation of warfare.

11. U.S. Foreign Policy and Diplomacy

Principal Investigator: Colonel Philip D. Caine, Department of History

Sponsored by The National War College

Research project involved the development of a course syllabus for the National War College for the spring semester, 1978. The course was designed to acquaint future national leaders with the development of U.S. foreign policy and the basic principles that have driven that policy over time.

12. International Politics and Strategy

Principal Investigator: Colonel Philip D. Caine, Department of History

Sponsored by The National War College

Research project involved the development of a course syllabus for the National War College for the fall semester, 1978. This became the syllabus for the core curriculum required of all students. It focuses on the International System, the Superpowers, the regional powers and includes a political-military simulation. It encompasses the required core courses from August through December, 1978.

13. The Periodical Press and the London Naval Conference

Principal Investigator: Colonel Philip D. Caine, Department of History

Sponsored by The National War College

This research examines the periodical press reaction to the London Naval Conference of 1930 as a reflection of American public opinion and resulted in a paper that was presented at the Third Conference on War and Diplomacy, The Citadel, Charleston, South Carolina, 9 March 1978.

14. The American Military Establishment and the Creation of a Postwar Overseas Military Base Network, 1942-1948

Principal Investigator: Captain Elliott V. Converse, III, Department of History

Sponsored by USAF Academy

This research is for a doctoral dissertation that examines the planning by various sectors of the United States military establishment for an extensive postwar overseas base system and the military's efforts to have these plans implemented following World War II. The emphasis is on an analysis of the adaptation of plans to changing forces and circumstances.

15. Modern Warfare and Society

Principal Investigator: Captain Robert C. Ehrhart, Department of History

Sponsored by USAF Academy

The research and writing in this project has produced a thoroughly revised edition of the basic textbook for the core course in military history.

16. Timothy Walker and the Growth of American Law

Principal Investigator: Captain Walter T. Hitchcock, Department of History

Sponsored by AFIT

A biography of Timothy Walker (1802-1856), noted legal author, educator, reformer and jurist. Walker, who practiced law in Cincinnati, Ohio, founded the University of Cincinnati Law School in 1833, edited the Western Law Journal, and authored a legal textbook entitled Introduction to American Law which was commonly regarded as the "American Blackstone." This study documents Walker's efforts to elaborate and implement a clear, authoritative national system of law that accommodated English common law to the spirit and condition of the western frontier.

17. Family Structure in a Colonial New England Town

Principal Investigator: Major Russell W. Mank, Jr., Department of History

Sponsored by USAF Academy

This research involves a study of Northampton, Massachusetts and examines the demographic, economic, and familial circumstances affecting the lives of colonists living in a western Massachusetts community in the seventeenth and early eighteenth centuries.

18. The Role of the Colorado National Guard in Civil Disturbances

Principal Investigator: Major Alan M. Osur, Department of History

Sponsored by USAF Academy

Looks at the specific role of the Colorado National Guard in handling civil disturbances within the state of Colorado. From Sand Creek to the Colorado Coal War, the Guard was freely used and became the center of much controversy. This investigation discusses topics such as: how political was the Guard, was there sufficient control over its use of violence, was it efficiently used, what were its legal bounds and did it stay within these bounds, and how did it change with the times?

19. General Hoyt S. Vandenberg, Sr.

Principal Investigator: Lt Colonel Jon A. Reynolds, Department of History

Sponsored by USAF Academy

Research has concentrated on the early career of General Vandenberg, from his graduation at West Point in 1923 to the end of World War II when he was Commander of 9th Air Force. Research has been conducted in the Library of Congress, the National Archives, and the Air Force Archives (Maxwell AFB). Personal interviews with General Vandenberg's contemporaries have also been conducted.

20. The Creation of the GHQ Air Force

Principal Investigator: Major John F. Shiner, Department of History

Sponsored by USAF Academy

Investigates the interplay between the War Department General Staff and military aviators which produced the GHQ Air Force in 1935. Research resulted in the publication of "The Birth of the GHQ Air Force" in Military Affairs, October 1978.

21. General Benjamin Foulois and His Air Corps

Principal Investigator: Major John F. Shiner, Department of History

Sponsored USAF Academy

Examines the changes that took place in the Army air arm between 1931 and 1935, as well as the Chief of Air Corps' part in these changes. The research was initiated as a doctoral dissertation (completed 1975), and work is continuing to prepare the dissertation for publication in book form by the Office of Air Force History.

22. The 1934 Air Mail Fiasco

Principal Investigator: Major John F. Shiner, Department of History

Sponsored by USAF Academy

Investigates the Air Corps' poor showing in 1934 when it was tasked to carry the air mail. Research centers on General Benjamin Foulois' part in this episode. Research has resulted in an article to be published by Aerospace Historian in late 1978.

23. The Military Profession in America

Principal Investigator: Major John F. Shiner, Department of History

Sponsored by USAF Academy

Examines the issue of military professionalism as it relates to today's Air Force. Considers professional ethics and the attributes of the professional officer and NCO. Research has resulted in an article to be published in Modern Warfare and Society, the locally produced textbook for History 202. It has also resulted in an article that will be submitted to Air University Review.

24. The Air Corps-Navy Struggle over the Coast Defense Mission, 1920-1941

Principal Investigator: Major John F. Shiner, Department of History

Sponsored by USAF Academy

Investigates the Air Corps' quest for control of the coastal air defense mission and the struggle with the Navy that ensued. Explores the Army-Navy agreements on the issue which left the U.S. with an uncoordinated, inadequate air defense structure at the time of Pearl Harbor. Research has thus far resulted in a paper delivered at the 12th Annual Military History Conference, of the Committee on Abandoned Military Posts, April, 1978, in Minneapolis, MN. It is now being prepared in article form for publication in a scholarly journal.

25. The Career of the Reichswehr Officer

Principal Investigator: Major David N. Spires, Department of History

Sponsored by USAF Academy

Analysis of the Reichswehr, Germany's Army during the Weimar Republic, in terms of its unique professional military nature. Special emphasis is placed on officer education, training, and career opportunities and their impact during the Weimar Republic and the Third Reich.

F. Department of Law

1. Personal Estate Planning (13th ed., 1978, 142 pp.)

Principal Investigator: Colonel Marcos E. Kinevan, Department of Law

This work provides a comprehensive analysis of techniques for estate accumulation and distribution. Topics covered include savings and credit, survivors' benefits, estate programming, casualty insurance, life insurance, investment fundamentals, estate and gift taxation, forms of property co-ownership, trusts and wills. The book is written for the layman, as a guide and to create an awareness of methods that might be used to successfully acquire and manage an estate, provide for family financial needs, and later arrange for property disposition that will best meet the owner's objectives. This material is distributed to cadets enrolled in Law 400; commercial publication is pending.

2. Copyright in Works Prepared Using Government Resources

Principal Investigator: Major Phillip A. Johnson, Department of Law

The new federal copyright law effective January 1978 was analyzed together with AFR 30-30 and AFR 110-8 to determine what copyright and conflict of interest principles apply to textbooks, articles, and theses prepared by USAFA faculty members in varying circumstances. Some guidelines emerged, but fundamental ambiguities have been referred to HQ USAF for resolution.

3. The Vagueness Doctrine and Cadet Disenrollment for Other Misconduct under AFR 53-3

Principal Investigator: Captain Kenneth E. Bunge, Department of Law

Legal research and opinion concerning whether cadet disenrollment for "other misconduct" violates substantive due process rights due to vagueness under the Fifth and Fourteenth Amendments of the United States Constitution, and federal court decisions interpreting those provisions.

4. Disclosure of United States Air Force Academy Library Patron Records to Law Enforcement Agencies

Principal Investigator: Captain Kenneth E. Bunge, Department of Law

Legal research and opinion concerning the disclosure of USAF Academy library patron records to law enforcement officials in the course of official investigations, taking into consideration the requirements of the Privacy Act of 1974 as well as other policy considerations.

5. Public Access to Oral History Interview Tapes and Transcripts

Principal Investigator: Major Burrus M. Carnahan, Department of Law

Legal research and opinion concerning whether the public should have access to oral history transcripts that have no access statements, and whether existing access statements properly limit use of the transcripts. The impact of both the Freedom of Information Act and the Privacy Act are considered.

6. Publication of Article Prepared for Classroom Use at USAFA

Principal Investigator: Major Burrus M. Carnahan, Department of Law

Legal research and opinion concerning whether such an article is copyrightable, and whether the author is eligible to receive compensation for its later publication.

G. Department of Mathematical Sciences

1. Math Achievement Test Analysis

Principal Investigator: Captain John W. Shimp, Department of Mathematical Sciences

Sponsored by the Department of Mathematical Sciences, USAFA

The purpose of this research is to investigate the ability of the College Board Mathematics Achievement Test (MAT) to predict student GPA performance in first year core mathematics and chemistry. Thus far a disk file of student scores has been constructed for the majority of the Class of 1981. Correlation analyses will be conducted to compare: (a) MAT scores with cumulative GPA for math and chemistry courses, (b) MAT scores with the grade in each math and chemistry course, and (c) grades in pairs of math and chemistry courses. For narrow ranges of MAT scores a probability distribution model of grades (A,B,C,D,F) will be built for each course and the expected course grade will be computed. From the above a cumulative GPA distribution and expected GPA for each range of MAT scores will be computed.

## 2. Core Math Data Base

Principal Investigators: Major Kenneth R. Keck and Captain Max A. Stafford, Department of Mathematical Sciences

Sponsored by Department of Mathematical Sciences, USAFA

The intent of this project is to build a data base of core mathematics problems and questions to be used for homework, boardwork, quizzes, graded reviews, and final exams. The desire is to reduce duplication of problem generation, to improve the quality of the problems, and to generate more equitable examinations. The work has generated an index (subject and alphabetical), a source data base of problems, a master file of typed problems, and instructor and student copies of the base. A large variety of problems have already been completed for four of our five core courses (Math 220 excluded). The base is now being actively used. For example, a large number of theory-type problems and questions were added to the data base for the Math 131 area of the core. Nine sets of the masters were generated for course director use in course generation. Math 131 is now drawing its homework and boardwork exclusively from the data base. A complete student version consisting of problem statements and final answers was generated. A file of handouts and training aids using the same indexing scheme was begun.

## 3. An Individualized Mastery System of Instruction in Core Mathematics

Principal Investigators: Major Samuel B. Thompson and Captain John M. Shimp, Department of Mathematical Sciences

Sponsored by the Department of Mathematical Sciences, USAFA

Salient features of the individualized mastery system were individual pacing with required demonstration of mastery performance criteria at prescribed milestones as conditions of further progress; a modularized objective-based curriculum with required and optional content domains; an emphasis on learner self-reliance supported by a grade point system that explicitly rewarded self-discipline, effective planning and initiative; and a rotating internal proctor system. Approximately 420 fourthclass cadets from squadron 1 through 20 were assigned to traditional (TR) instruction in Calculus 1 with a similar number from squadron 21 through 40 assigned to individualized mastery (IM) instruction. Six instructors were assigned to each instructional treatment by a stratified random procedure. Treatment groups were compared for differences in math achievement, math reading comprehension, fail rates, out-of-class study time, performance in concurrent academic courses, instructor man-hours, and attitudes. Tracking of the treatment groups for residual differences

attributable to the distinct Calculus 1 instructional treatments is continuing through academic year 1977-78. A full report on this study is available in the Special Collections of the USAFA Library.

#### 4. Cost Containment in Military Medical Care

Principal Investigators: Lt Colonel Isham C. Shields and Major Joseph C. H. Smith, Department of Mathematical Sciences

Sponsored by the Office of the Secretary of Defense

The purpose of this study is to investigate the uniformed services use of doctors vis a vis the CHAMPUS program. Analysis of data for fiscal year 1977 revealed some anomalies when a regression was performed by regressing the number of CHAMPUS patients against the number of doctors for each military hospital. OSD has requested that we monitor this for the next year at least.

The purpose of a second study area is to determine means of better utilization of military health care facilities. For example, some areas of the U.S. have military hospitals in close proximity that have enough excess bed capacity to allow one hospital to be closed. This study is to investigate this and in addition to determine communities where it may be more feasible to allow civilian health care facilities to provide health care for the military. This study is part of President Carter's proposal to reorganize the federal government. The final report on the study is due 1 November 1978. There will be follow-on studies.

#### H. Department of Philosophy and Fine Arts

##### 1. On the Nature of Man

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

This three-hour lecture examined fundamental views of the nature of man developed in ancient Eastern philosophies, the classical Greek Tradition, Judeo-Christian writings, and the works of modern European thinkers. The classical views were contrasted with those of contemporary existentialism, and special attention was given to comparisons of the Marxist view of man with that of the Greek-Judeo-Christian tradition.

##### Presentation

Presented at the opening session of the academic year at the Inter-American Defense College on 12 September 1977.

## 2. Managerial Integrity

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

This two-hour lecture is a continuing project, evolving through several years of research, concentrating on the ethical dimensions of personnel management.

### Presentation

Versions of this lecture were presented at Maxwell AFB for the Advanced Personnel Management Course on 15 September 1977, 13 January 1978, 24 March 1978, and 23 June 1978.

## 3. Professionalism in Military and Federal Service

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

This work represents a continuing study of professionalism in several vocations, applied in this instance to public administrators in comparison to military leaders.

### Presentation

Abbreviated paper delivered at a regional meeting of the American Society of Public Administrators, held at the USAF Academy on 6 November 1977.

## 4. Ethics and Institutions

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

A critical review of the ethical issues and responsibilities of institutions and institutional workers, especially aimed at correctional institutions.

### Presentation

A two-hour presentation to the Colorado State Institutions Chaplains at the USAF Academy on 17 November 1977.

## 5. Become the Ethical Dream

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

A searching look at the role of the military chaplain: as minister, as staff officer, and as the conscience of commanders.

Presentation

Presented as a major paper to military chaplains and others at the National Meeting of the Military Chaplains Association, at the USAF Academy on 12 April 1978.

6. Christian Morality and the Cadet Honor Code

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

An evaluation of applications of the Cadet Honor Code in the broader context of Christian moral teaching. A critical analysis of the nature of moral codes and subtle dangers inherent in them is made with special attention paid to "legalisms" and narrow interpretations of personal honor.

Presentation

Speech delivered as part of the Cadet Chaplains' Distinguished Speaker Series to members of the Cadet Wing on 17 April 1978.

7. Ethics and the Military Profession; War and Morality

Principal Investigators: Colonel Malham W. Wakin and Professor Robert L. Cunningham, Department of Philosophy and Fine Arts

This combined study is part of the continuing investigation of these topics in the department. Topics emphasized include the role or moral values in the function of military operations and decision-making, statistical reporting systems in the military, comparisons with other professions, comparative value systems in the military and civilian societies, just war considerations, the principle of double effect, treatment of noncombatants, and the question of moral innocence in war.

Presentation

4 Two five-hour workshops were given in team fashion by Colonel Wakin and Professor Cunningham at Fort Jackson, South Carolina, on 19 and 20 April 1978.

AD-A065 002

AIR FORCE ACADEMY COLO  
ANNUAL RESEARCH PROGRESS REPORT NUMBER 13, 1 JULY 1977-30 SEPT--ETC(U)  
OCT 78

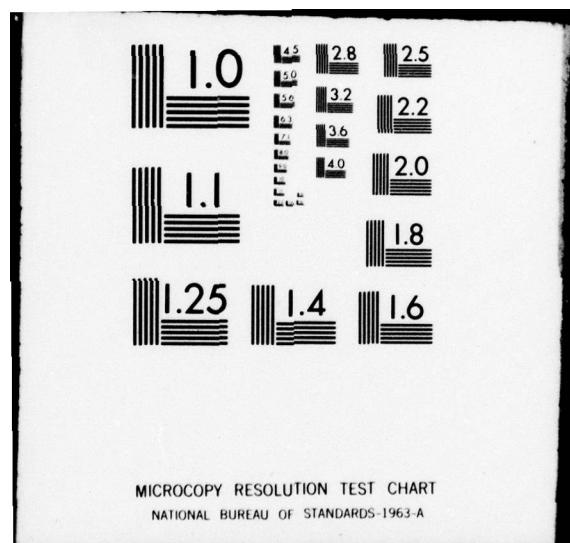
F/G 5/2

NL

UNCLASSIFIED

2 OF 2  
AD  
A065000





### 8. Whatever Happened to Sin

Principal Investigator: Colonel Malham M. Wakin, Department of Philosophy and Fine Arts

An investigation of the general moral climate of this decade stressing the obvious insensitivity to moral issues and criticizing various proposals for dealing with moral myopia. Sin is viewed in a real sense as being a necessary conception for human existence or at least for rational moral judgment. Important distinctions are made between sin and crime, between civil law and moral law.

#### Presentation

A paper given to a religious and lay audience at the Mount St. Francis home in Colorado Springs on 17 May 1978.

### 9. Lanka: A Visual Diary

Principal Investigator: Lt Colonel Carlin J. Kielcheski, Department of Philosophy and Fine Arts

While on a teaching sabbatical to the Independent Republic of Sri Lanka, Lt Col Carlin J. Kielcheski, Professor of Art, DFPFA, presented two exhibits of his art created in Ceylon. Comprised of twenty-six entries, fifteen paintings in acrylics and oils, three pen-and-pencil drawings, three woodcuts, and three wood sculptures in teak, jack, and satin wood, the display was representational or semi-abstract depictions of Sri Lankan life.

#### Exhibition

The exhibit was shown at the American Center in the Capitol City of Colombo from 12-18 May 1978 and the Library of Vidyalankara Campus of the University of Sri Lanka on 19 and 20 May 1978.

### 10. Managerial Ethics

Principal Investigator: Major Kenneth H. Wenker, Department of Philosophy and Fine Arts

A three-hour presentation on ethical concerns typically encountered in management. Uses Dostoevsky's "The Grand Inquisitor on the Nature of Man" and Kohlberg's research on the stages of moral development as a theoretical basis. Emphasizes the need for moral decisions which are simultaneously autonomous and principled. Examines several such principles and applies them to situations common to the manager in government service.

Presentation

Presented to the Personnel Management for Executives courses offered by the U.S. Army's Health Services Command for federal executives in grades GS-13 and above or the equivalent. Presented on 21 September 1977 at Austin, Texas, and on 1 March 1978 at Oklahoma City, Oklahoma.

11. Practicum in Ethics

Principal Investigator: Major Kenneth H. Wenker, Department of Philosophy and Fine Arts

A two-day workshop with seven hours of lectures on various ethical issues of concern to military commanders. Lays a theoretical foundation for defining morality and moral character. Explains several underlying principles of a mature morality. Identifies factors leading to unethical behavior in the armed forces. Emphasized the need for moral character on the part of military managers.

Presentation

Presented to battalion commanders and senior staff officers assigned to Fort Polk, Louisiana, 5-6 May 1978 at Many, Louisiana.

12. Professional Ethics

Principal Investigator: Major Kenneth H. Wenker, Department of Philosophy and Fine Arts

A two-hour presentation on ethical concerns critical to the military profession. Emphasizes the need for moral character on the part of military managers. Develops some principles typically held by persons of moral character and applies them to the military setting.

Presentation

Presented to the Air Command and Staff College's Associate Personnel Management Course at Maxwell AFB, Alabama, 5 May 1978.

13. War, Morality, and the Military Profession

14

Principal Investigator: Major James H. Parsons, Department of Philosophy and Fine Arts

This publication is an anthology of thirty articles which were assembled and are being printed locally for distribution to the core ethics course, Philosophy 310. The anthology is divided into four sections. Listed

below are the names of the four sections and the section editors who selected the articles for the various sections:

Military Professionalism (Colonel Wakin)

The Morality of War (Professor Cunningham)

Morality in War (Major Parsons)

The Laws of War (Captain MacDonnell)

Publication

This anthology is in the process of being printed at the USAFA printing facilities.

I. Department of Political Science

1. American Defense Policy

Principal Investigator: Lt Colonel John E. Endicott, Department of Political Science (co-editor, Major Roy W. Stafford, Jr.)

The fourth in the series of defense policy readers published by the department. It includes introductory pieces and edited articles on the full spectrum of issues arising in the process to assure us the best national defense. This issue stresses process but not to the exclusion of other meaningful areas of study; for example: the development of U.S. strategy, arms control, limited war, and the role of the military in a changing social and cultural environment.

Publication

Published by Johns Hopkins University Press, 4th Edition, 1977.

2. Counterinsurgency: The Thai Case

Principal Investigator: Captain William R. Heaton, Jr., Department of Political Science

The article outlines the Thai insurgency and the Thai government's response utilizing variables explained by Bard O'Neill. The Thai government's utilization of the environment, organization, popular support, and external support are analyzed. The conclusion is that the Thai government has not done a very effective job in counterinsurgency, but the insurgents have not been able to fully capitalize on this.

Publication

Published in American Defense Policy, 4th Edition, Johns Hopkins University Press, 1977, pp. 177-183.

3. The Politics of East Asia

Principal Investigator: Lt Colonel John E. Endicott with Captain William R. Heaton, Jr., Department of Political Science

This book is an undergraduate text on the politics of China, Japan, and Korea. Research was completed in 1977.

Publication

Published by Westview Press, Boulder, Colorado, 1978.

4. The Political Element in Professional Military Expertise

Principal Investigator: Lt Colonel Michael A. Freney, Department of Political Science

Twenty-year longitudinal analysis of curricular emphasis at National War College.

Publication

Published in American Defense Policy, 4th Edition, Johns Hopkins University Press, 1977.

5. The Ideology of Preparedness

Principal Investigator: Captain Ralph A. Froehlich, Department of Political Science

Book review of Preparing for the Next War - American Plans for Postwar Defense, 1941-45, Michael S. Sherry, New Haven, Conn, Yale University Press.

Publication

Published in Book Forum, Vol III, No 4, 1978, The Hudson River, Press, Rhinecliff, New York.

6. Defense Decision-making in the Organizational Bureaucratic Context

Principal Investigator: Major Chris L. Jefferies, Department of Political Science

Major Jefferies presents a summary and analysis of the organizational and bureaucratic constraints which limit the decisionmaker. He begins by summarizing and illustrating the application of Graham Allison's three models of decisionmaking: the Rational Actor, the top and center of a rational process; Organizational Processes, those processes which constrain the Rational Actor through routines, scenarios, and standard operating procedures; and Bureaucratic Politics, a model he further divides into (a) individuals playing the political game in the bureaucratic context, and (b) organizations themselves as players in the same context. All models he argues, filter the inward flow of information and outward flow of decision implementation. He concludes by diagramming the interrelationship of the four processes as they operate together.

Publication

Published in American Defense Policy, 4th Edition, Johns Hopkins University Press, 1977, pp. 227-239.

7. Public Administration and the Military

Principal Investigator: Major Chris L. Jefferies, Department of Political Science

The article addresses the problem of the lack of interaction between military administration and public administration by identifying the major causes of the lack of interchange, examples of the lack of interaction, and mutuality of the two fields. The article argues that there is a need for more interchange between the fields.

Publication

Published in Public Administration Review, July-August 1977, pp. 321-333.

8. In Case of Deluge: Where Nuclear Proliferation Meets Conventional Arms Sales

Principal Investigator: Captain Harold W. Maynard, Department of Political Science

This paper looks at the problems of nuclear proliferation in the Third World from the perspective of required ancillary systems. Conventional technology that relates to delivery, security, safety, targeting, survivability, reliability, and command and control are discussed as they impact upon a nation's ability to "go nuclear." The fundamental conclusion is that we should accept the inevitability of nuclear proliferation and tailor our arms sales policy to take this into account.

Publication

Published by Los Alamos Scientific Laboratories, Los Alamos, New Mexico, 1977.

9. How Military Elite Role Perceptions in Southeast Asia Conflict with the Civil-Military Paradigm

Principal Investigator: Captain Harold W. Maynard, Department of Political Science

This paper outlines the West's civil-military paradigm, with emphasis on its conceptual weaknesses. Then the views of Indonesian and Philippine military officers are presented with the aim of showing an alternate view of the military's "proper" role. Emphasis is placed on dichotomous roles, the security development role, and the contrasting perspective of different military institutions with regard to what constitutes legitimate military functions.

Publication

Published in Southwest Conference on Asian Studies, University of Texas, 1977.

10. Trends in Constitutional Development

Principal Investigator: Lt Colonel Curtis G. Cook, Department of Political Science

This presentation includes a discussion and analysis of recent cases on civil rights in the United States in the context of long-term trends.

Presentation

Seminar Presentation for Rhodes Scholarship candidates, USAFA, October 1977.

11. Legislative Liaison in DOD

Principal Investigator: Lt Colonel Curtis G. Cook, Department of Political Science

A description of the operation of Legislative Liaison and an analysis of the impact on defense programs.

Presentation

Seminar Presentation for students in Pol Sci 495, USAFA, November 1977.

12. The National Security Council System

Principal Investigator: FSO-4 Roger G. Harrison, Department of Political Science

This presentation included an explanation of President Nixon and President Ford's national security decisionmaking processes.

Presentation

Presented at Colorado College to International Relations Seminar, 11 October and 6 December 1977. Also presented to Mensa Society in Pueblo, 17 September 1977.

13. Analyzing Chinese Factions

Principal Investigator: Captain William R. Heaton, Jr., Department of Political Science

This presentation was made in Monterey, California, while TDY to the faculty of the NPS. It outlined approaches to understanding factionalism in China's leadership and discussed some variables which must be considered in understanding decisionmaking in China.

Presentation

Presented to the faculty of the Naval Postgraduate School, 25 August 1977.

14. Understanding China

Principal Investigator: Captain William R. Heaton, Jr., Department of Political Science

The presentation dealt with contemporary economic, political, and social aspects of the People's Republic of China.

Presentation

Presentation before the ADC Air War College Seminar at Peterson AFB, Colorado, on 4 October 1977.

15. Panama Canal Treaties

Principal Investigator: Captain James M. Keagle, Department of Political Science

Presentation dealt with major issues being raised by those favoring and those opposing ratification of the recently negotiated treaties.

Presentation

Presentation to students, East Junior High School, Colorado Springs, Colorado, September 1977.

16. Congressional Elections: Incumbency and Service to Constituents

Principal Investigator: Lt Colonel John D. Macartney, Department of Political Science

Presentation

Conference on congressional elections of the National Elections Study Project of the Center for Political Studies of the University of Michigan. Held at Rochester University, October 1977.

17. President Carter's Foreign Policy

Principal Investigator: Lt Col John D. Macartney, Department of Political Science

Presentation

Presented to ACSC non-resident seminar, USAFA, October 1977.

18. Military Roles in Southeast Asia

Principal Investigator: Captain Harold W. Maynard, Department of Political Science

5

This was a 30-minute presentation to fellow academies on how Thai, Indonesian, and Philippino officers view their role in society and what internal pressures they encounter.

Presentation

Western Conference of the Association of Asian Studies, USAFA, October 1977.

19. The Central Mystery of Political Science and the Study  
Canadian Defense Policy--Is It Time For a New Approach?

Principal Investigator: Major Douglas J. Murray, Department of Political Science

Paper analyzes the existing approaches to the study of defense policy and concludes that they fail to take into consideration the relationship between domestic and international politics. An alternate approach is suggested.

Presentation

4th Biennial Conference of the Association of Canadian Studies in the United States, Burlington, VT, 7-8 October 1977.

20. Hot Spots in Today's World

Principal Investigator: Captain Roger I. Pinnell, Department of Political Science

Seminar presentation of leftist hot spots throughout the world with particular attention to Africa and Europe.

Presentation

Presented to the officers of 3d Battalion, 24th Armor, Ft Carson, Colorado, December 1977.

21. POW Experiences

Principal Investigator: LCDR Theodore G. Stier, Department of Political Science

This presentation dealt with personal experience as a POW in North Vietnam and the adequacy of the Code of Conduct.

Presentation

Guest speaker at the Naval ROTC Ball, University of Colorado, Boulder, Colorado, October 1977 and to officers of 3d Battalion, 24th Armor, Ft Carson, Colorado, December 1977.

22. NATO Defense Planning

Principal Investigator: Colonel Ervin J. Rokke, Department of Political Science

Discussion of principle policy issues in NATO defense planning, including standardization, interoperability, and planning processes.

Presentation

Discussion Group on NATO Defense Strategy, Council on Foreign Relations, New York, New York, December 1977.

23. Presidential Memorandum #10

Principal Investigator: Major John D. Szostak, Department of Political Science

An analysis of President Carter's defense policy recommendations as outlined in NSC Presidential Review Memorandum #10.

Presentation

Presented at an ACSC Seminar, September 1977.

24. President Carter's Foreign Policy

Principal Investigator: Major John D. Szostak, Department of Political Science

An analysis of the implications of President Carter's foreign policy programs for NATO Defense Policy.

Presentation

Presented at Rhodes Scholarship Seminar Program, USAFA, October 1977.

25. The Other Wiseman

Principal Investigator: Captain John A. Wahlquist, Department of Political Science

15

A retelling of the Christmas story, The Other Wiseman, by Henry Van Dyke, emphasizing the Christian concept "inasmuch as ye have done it unto one of the least of these my brethren, ye have done it unto me."

Presentation

Academy Ward, The Church of Jesus Christ of Latter-day Saints, Colorado Springs, Colorado, 17 December 1977.

26. Ethical Considerations of Nuclear War

Principal Investigator: Captain John A. Wahlquist, Department of Political Science

A discussion of the ethical and moral considerations that each officer must face when confronted with the employment or threat of employment of nuclear weapons in warfare.

Presentation

Presented to Second and Third Class Cadets, CWDS-13 and 33, USAFA, 24 September 1977 and 1 October 1977.

27. The Role of the Military in Arms Limitation

Principal Investigator: Captain Harold W. Maynard, Department of Political Science

This paper addressed both the historic role played by the U.S. military and the current positions taken by the JCS on arms limitation agreements.

Presentation

Presented to an Inter-University Seminar on Armed Forces and Society, Dallas, Texas, March 1978.

28. NATO's Long Term Defense Plan

Principal Investigator: Major John D. Szostak, Department of Political Science

An analysis of the NATO Long Term Defense Plan, SALT, and current issues surrounding NATO today.

Presentation

Presented at a visit to Armed Forces Intelligence Training Center, 9 June 1978.

29. Strategic Balance and Arms Control Talks

Principal Investigator: Captain George C. Gibson, Department of Political Science

This presentation was a discussion of the current strategic balance, possible Soviet weapons leads, and how these relate to SALT talks.

Presentation

Presented to an Air Command and Staff seminar, USAFA, April 1978.

30. Political Analysis of Soviet Intentions

Principal Investigator: Captain Schuyler Foerster, Department of Political Science

This presentation examined the difficulties in discerning the difference between capabilities and intent of Soviet military power and discussed the factors affecting Soviet employment of force in the postwar period.

Presentation

USAFA faculty seminar on Defense Policy Issues, USAFA, 1 February 1978.

31. Elements of Soviet Power - Strengths and Weaknesses

Principal Investigator: Captain Schuyler Foerster, Department of Political Science

This presentation discussed the strengths and weaknesses of Soviet military power, focusing on military training, economics, and demographic factors.

Presentation

ASCS Seminar, USAFA, February 1978.

32. Dilemmas of World Energy

Principal Investigator: Major Kenton E. Lammers, Department of Political Science

This presentation dealt with the implications for domestic energy policies of excessive U.S. oil import dependence.

Presentation

Great Discussions Study Group, Faith Presbyterian Church, Colorado Springs, Colorado, March 1978.

33. The Politics of Energy

Principal Investigator: Major Kenton E. Lammers, Department of Political Science

This presentation was an assessment of the difficulties of drafting and implementing a comprehensive national energy plan for the U.S.

Presentation

Physics 496, USAFA, May 1978.

34. NATO Strategy

Principal Investigators: Lt Colonel Michael A. Freney, Captain Charles Fox, Department of Political Science

A discussion of existing NATO strategy, Warsaw Pact posture, and how they relate.

Presentation

Two sessions of the Allied Intelligence Officers Course in January and March 1978, and four Air Command and Staff and Air War College Non-Resident Seminars during the period August 1977 - May 1978.

35. The President's Commission on Military Compensation Proposals: A Legislative Strategy

Principal Investigator: Major Paul R. Viotti, Department of Political Science

Sponsored by: Office of Management and Budget

A review of findings of the President's Commission on Military Compensation is followed by a set of suggestions on how best to achieve objectives identified by the Commission. Specific attention to Congressional attitudes and probably reactions are emphasized.

Publication

Working paper for Office of Management Budget, August 1978.

36. The Evaluation of the U.S.-Canadian Defense Economic Relationship and Its Applicability to NATO Standardization

Principal Investigator: Major Douglas J. Murray, Department of Political Science

Sponsored by: Office of the Assistant Secretary of Defense,  
International Security Affairs

The study analyzes the utility of the U.S.-Canadian Defense Production and Development Sharing Programs as models for NATO standardization programs.

Publication

Published as an Office of Economic Affairs Research Note by the Assistant Secretary of Defense, International Security Affairs, March 1978.

37. NATO and Oil: Conflict and Capabilities

Principal Investigator: Major Chris L. Jefferies, Department of Political Science

The study analyzes the probable impact of oil shortages upon major international political actors, and the consequences of those shortages for the North Atlantic Treaty Organization.

Publication

Working paper for the Directorate of Doctrine, Concepts and Objectives, Headquarters, U.S. Air Force.

38. Justifying the MX

Principal Investigator: Captain George C. Gibson, Department of Political Science

Sponsored by: Los Alamos Scientific Laboratories and the Directorate of Plans, Headquarters, U.S. Air Force

The study identifies the principal variables to be considered when analyzing the desirability of new strategic missile systems.

Publication

Working paper for the sponsors.

39. Independent Review and Assessment of Space and Missile Systems Organization Test and Evaluation Architecture

Principal Investigators: Captain Robert J. DeSutter, Department of Political Science; Captain Charles F. Stirling, Department of Astronautics and Computer Science; Cadet First Class Bruce J. Bingle

Sponsored by: Space and Missile Systems Organization, Air Force Systems Command

The study examines existing test and evaluation channels and procedures and recommends substantial revision to improve effectiveness and efficiency.

Publication

Submitted as Final Report to the Test and Evaluation Steering Committee, Space and Missile Systems Organization, Air Force Systems Command.

40. Recent Trends in Administration and Congressional Attitudes Impacting on Reentry Technology

Principal Investigator: Captain Ralph A. Froehlich, Department of Political Science

Official transcripts, voting records, and published statements are examined to gain a sense of the climate for discussion of reentry vehicle programs.

Publication

Submitted as a working paper to Space and Missile Systems Organization, Air Force Systems Command.

### III. RESEARCH AND ANALYSIS OF SPACE AND WEAPONS SYSTEMS

#### A. Department of Astronautics and Computer Science

##### 1. Research Support for the NACSTAR Global Positioning System (GPS)

Principal Investigators: Project Officer, Major Jackson R. Ferguson, Jr. Major Leonard R. Kruczynski and Captains Paul F. Torrey and George T. Kroncke, and 2LT Richard D. Beery, Department of Astronautics and Computer Science

Sponsored by GPS Joint Program Office (SAMSO/YE)

The Department of Astronautics and Computer Science is supporting the Global Positioning System Program by performing varied research as requested by SAMSO/YEE. Honeywell Systems Research, Inc., and USAFA/DFACS are jointly performing an independent verification of the Rockwell International design for the NDS satellite. The following particular topics have been researched by DFACS personnel.

###### a. GPS Magnetic Momentum Dumping Control Program

Principal Investigators: Captain Kroncke and Major Ferguson, Department of Astronautics and Computer Science

The Global Positioning System required precise ephemeris data. A primary cause of ephemeris errors is the RCS momentum dumping. This research formulated a ground based system to achieve magnetic momentum dumping.

An algorithm for determining the settings for residual field balancing magnets has been devised. Constraints are:

- (1) Only two magnets are available;
- (2) Switches occur within sight of a ground station; and
- (3) Commands cannot be stored on the spacecraft.

The method developed requires changes in the magnets either three or four times in a day occurring at zero degrees, 90 degrees, 180 degrees, and 360 degrees in argument of latitude. Results indicate that the expected momentum buildup can always be dumped magnetically. A control program has been implemented at the Air Force Satellite Control Facility. Testing will occur after DSARC.

b. GPS Constellation Studies

Principal Investigators: Captain Kroncke, Major Ferguson, and 2Lt Beery, Department of Astronautics and Computer Science

This research was to find a satellite constellation which gives improved earth coverage over the baseline GPS constellation and to investigate satellite failure geometry. Simulations were run determining the coverage for over 30 constellations. The coverage was compared against that for the baseline constellation. The comparison was made on:

- (1) Fewest number of satellites ever seen;
- (2) Percent of the time that the minimum was seen;
- (3) Location of the smallest minimums;
- (4) Percent of the earth's surface which sees each of the minimums;
- (5) Average number of satellites seen at different locations; and
- (6) Average and maximum GDOP values.

The results are several satellite constellations which give improved coverage and use fewer satellites.

c. GPS User Navigation During the Limited Operational Capability Phase (Phase II)

Principal Investigator: Major Kruczynski, Department of Astronautics and Computer Science

During Phase II GPS, a user will not usually see four satellites as desired for accurate three-dimensional positioning. This research investigates the performance characteristics of various algorithms during the Phase II time period. The user is assumed to be a cargo-type aircraft with inexpensive GPS equipment and with a barometric altimeter.

## 2. Air to Air Fire Control Research

### Laboratory Test of the ASCOT Electro-optical Tracker Aided by a Digital Estimator

Principal Investigators: Lt Colonel Edward J. Bauman, Major Roger P. Neeland and Captain Joseph E. Justin, Department of Astronautics and Computer Science

Associate Investigators: Captains Carl C. Schade and James A. Davis, Department of Astronautics and Computer Science

The digital six-state estimator developed earlier here for the Bendix ASCOT (Adaptive Scan Optical Tracker) was implemented on a ROLM 1664 airborne minicomputer. Interfaces and control logic for this computer, which will be used in airborne tests of the aide tracker/director gunsight, were developed in conjunction with Bendix personnel and a consultant, Dr. Charles Fosha. Using the computer, it was possible to estimate target position and aid the ASCOT in tracking through regions of high optical clutter.

An extensive two-dimensional air-to-air simulation was developed to determine accuracies of the filter/ASCOT combination to be expected in actual airborne testing. Various parameter sensitivity studies were performed.

This concept of aided tracking with the ASCOT has now been verified and the Air Force Avionics Laboratory has awarded a large commercial contract to further test this equipment in an F-106 aircraft at Tyndall AFB, FL.

## 3. Independent Review and Assessment of SAMS0 Test and Evaluation Architecture

16

### Summer Research - Completed in August 1978

Principal Investigators: Captain Charles F. Stirling, Department of Astronautics and Computer Science; Captain Robert J. DeSutter, Department of Political Science; and CIC Bruce A. Bringle, CS-18

Sponsored by Hq Space and Missile Systems Organization (SAMS0), Directorate of Acquisition Support (AW)

The purpose of the study was to review SAMSO Test and Evaluation procedures, to characterize the T&E organization and test structure, and to develop recommendations for increased test effectiveness. The study was organized to compare a theoretical T&E model to the actual T&E structure at SAMSO. Conclusions, recommendations, and suggestions for further study were based on the disparity that exists between the two.

Data was collected and analyzed between 23 May and 31 July 1978. After a thorough study of applicable documentation produced a theoretical model, a lengthy process of interviewing key SPO personnel was accomplished. A formatted questionnaire was used, and discussions with each respondent were focused on the same issues. The areas of interest were: Overall Test Philosophy; SPO Organizational Structure and Function; Development Test and Evaluation; Operational Test and Evaluation; SAMSO Staff Test and Evaluation Support; AFTEC's Role in Space; and Lessons Learned.

The fundamental conclusion of the study was that a SAMSO T&E architecture does not exist on an organization-wide basis. SAMSO's intentional philosophy on SPO autonomy has contributed significantly to each SPO having its own test structure. The study recommended that a new focal point at SAMSO be created for T&E at the command level. This office should seek to instill expertise on T&E into all future decisions concerning SAMSO programs.

#### Presentations

Preliminary findings briefing to SAMSO Test Steering Committee on 26 June 1978.

Final presentation on research findings on 26 September 1978 to the SAMSO Test Steering Committee.

Final Report Published: "Independent Review and Assessment of SAMSO Test and Evaluation Architecture," August 1978.

#### 4. Automation of the AF Form 1537

Principal Investigators: Captains William E. Ayen and Douglas E. Lyda, Department of Astronautics and Computer Science

Sponsored by F-16 SPO

The development was accomplished using a three phase approach. Phase one was the straight forward production of just the AF Form 1537 from given line item data. Phase two traced the contractor furnished portion of costs back to their basic learning curve algorithms.

The primary and support software was created using the GE DMS2 data base management language and consists of more than 50 programs called the F-16 Estimating and Budgeting System (FEBS). The data requirements are all user supplied and are not program intrinsic. This data consists of production schedules, manufacturing cost rates, learning curve algorithms, and miscellaneous supporting data.

#### 5. Software Development for Drones

Principal Investigator: Captain Robert J. Kirkpatrick, Department of Astronautics and Computer Science

Associate Investigator: Captain Helen D. Knight, Department of Astronautics and Computer Science

Sponsored by 11th Tactical Drone Squadron

In response to a request from the 11th Tactical Drone Squadron at Davis Monthan AFB, the Department of Astronautics and Computer Science automated the flight planning process for drone missions on the PDP-11 computer. Primary emphasis was placed on interactive flight planning in a natural English-like language. Work progressed through the command interpreter, flight performance chart digitization, flight planning equation production and equation validation but was halted short of a full-scale test because of problems with hardware acquisition.

#### 6. Economic Price Adjustment Model

Principal Investigator: Captain Marion A. Pumfrey, Department of Astronautics and Computer Science

Sponsored by the F-16 SPO

The objective of the research was to automate the F-16 price adjustments in accordance with the Economic Price Adjustment Document 00 6F0-613-2-2.

#### 7. Data Compression and Display Techniques

Principal Investigators: Major David G. Karpinski and Captain Louis A. Machuca, Department of Astronautics and Computer Science

Sponsored by ADCOM

This project enhanced ADCOM's responsiveness to changing detection system status by inclusion of satellite detection in the probability figures, better organization of the data in random access disk files, and more flexible, quicker generation of probability maps.

B. Department of History

The X-15's Role in Aerospace Progress

Principal Investigator: Captain Ronald G. Boston, Department of History

Sponsored by Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, OH

Research and report analyzes the contribution of the X-15 in furthering aviation.

#### IV. MANPOWER, PROCUREMENT AND LOGISTICS STUDIES

##### A. Department of Economics, Geography and Management

###### 1. A General Technique for R&D Cost Forecasting

Principal Investigator: Major William J. Weida, Department of Economics, Geography and Management

A general model for R&D cost forecasting was developed based on an expenditure pattern analysis of twenty-one current weapon systems. This model, which was validated on an additional twelve weapons systems, shows that R&D expenditures follow a certain, well-defined pattern, regardless of the type of system involved.

###### Publication

USAFA-TR-77-12, USAF Academy Technical Report, September 1977; Proceedings of the 40th MORS, January 1978; Proceedings of the 41st MORS, August 1978; and the Proceedings of the Procurement Research Symposium, September 1977.

###### 2. Management Science Applications in the Arena of the Operational Air Force

Principal Investigator: Major William J. Weida, Department of Economics, Geography and Management

###### Presentation

Air University Professional Comptroller School, October 1977.

###### 3. A General Model for R&D Cost Forecasting

Principal Investigator: Major William J. Weida, Department of Economics, Geography and Management

###### Presentation

40th MORS, Monterey, California, December 1977 and 41st MORS (Rist Prize Paper Competition), Washington, D.C., June 1978.

###### 4. Forecasting Air Force Expenditures in the 3600 Category

Principal Investigators: Major William J. Weida, 2Lt Steven Clark, and 2Lt James Rowland, Department of Economics, Geography and Management

Presentation

USAF Budget Office, September 1977.

5. Observable Preference for Public Goods

Principal Investigator: Major Gregory G. Hildebrandt, Department of Economics, Geography and Management

Associate Investigator: Professor David F. Bradford, Princeton University

The report discusses the circumstances under which it is possible to use the market or aggregate demand function generated from individual utility maximization to obtain the consumers' preferences for certain classes of public goods, and thus obtain the information needed to satisfy the Samuelsonian efficiency conditions for these public goods. The restrictions on the preferences of all consumers which are sufficient to use the aggregate demand function are (i) there exists a price vector such that the level of public good provision is valueless and (ii) the marginal rate of substitution of price for the level of public good provision is independent of income.

Publication

Journal of Public Economics, October 1977.

6. Nursing Cost Prediction for Budgeting and Control

Principal Investigator: Lt Colonel F. Theodore Helmer, Department of Economics, Geography and Management

Presentation

Hospital Management Systems Society, Biloxi, Mississippi, February 1978.

7. The Evaluation and Utilization of Tanker Cargo Aircraft

Principal Investigators: Lt Colonel F. Theodore Helmer and 2Lt Paul Don Levy, Department of Economics, Geography and Management

The optimal utilization of future tanker/cargo aircraft for a variety of tanker missions with all combinations of fighter aircraft and a myriad of destinations creates a complex operations research program. The computer program "Tankerdecision" is capable of evaluating range versus

payload information provided by the RAND "FARM" computer program. The output includes fighter deployment costs, feasibility studies and resulting payloads for various combinations of tanker/cargo, fighter, tanker, and cargo aircraft. The Tankerdecision output would be extremely useful in evaluating alternative tanker/cargo aircraft based upon cost and performance. In addition, the efficiency of deploying various fighters, fighter configurations, and payloads can be evaluated. The effect of improved lifecycle costs can also be evaluated. Finally, the Tankerdecision computer program can evaluate a tanker/cargo aircraft in a role approximating a pure tanker or a pure cargo aircraft.

Publication

USAFA-TR-78-7, USAF Academy Technical Report, February 1978.

8. Replacement Cost Accounting: Its Possible Effects on Government Contracts

Principal Investigators: Captain Robert E. Pizzi and Captain Regis Canny, Department of Economics, Geography and Management

Presentation

7th Annual Acquisition Research Symposium, 31 May-2 June 1978.

9. Review of the Application of the O&S Cost Model to the A-10 Program Contractor Incentive Award Fee

Principal Investigators: Captain Arthur L. Moxon, CIC Michael Clark, and CIC Glen Forsyth, Department of Economics, Geography and Management

A final review of the application of the O&S Cost Model to the A-10 Program Contractor Incentive Award Fee was undertaken at the request of Brig General Rutter, Vice-Commander of the AFALD. A research proposal was developed by the Business Research Management Center at Wright-Patterson AFB, Ohio, to address four basic areas: (1) Describe the background and implementation of the O&S Cost Model as applied to the A-10 program, (2) Provide a critical analysis of the technique involved, (3) Identify the positive effects of the A-10 O&S Cost Model application, and (4) Provide a summary of the lessons learned.

Publication

USAFA-TR-77-16, USAF Academy Technical Report, October 1977.

10. Follow-up Recommendations Presented in A-10 O&S Model Review

Principal Investigator: CIC Glen Forsyth, Department of Economics, Geography and Management

Publication

USAFA-TN-78-7, USAF Academy Technical Note, May 1978.

11. Forecasting Retail Sales in AAFES, Conus at Headquarters Army and Air Force Exchange Service

Principal Investigators: 2Lt Michael Clark, 2Lt James Rowland, and Major William J. Weida, Department of Economics, Geography and Management

Data for sales at all Conus exchanges were gathered and analyzed to determine the factors which affect AAFES sales. The resultant model exhibited an almost perfect correlation between sales in the current year and those in the past year for the same quarter.

Publication

USAFA-TN-78-8, USAF Academy Technical Note, August 1978.

12. A Model for Management of USAFA Cadet Uniform Inventory

Principal Investigators: 2Lt Steven Clark, 2Lt William Frey, and Major William J. Weida, Department of Economics, Geography and Management

The cadet uniform inventory system was investigated to determine whether the current model for ordering uniforms was adequate. It was determined that several major changes to the model should be made.

Publication

USAFA-TN-78-9, USAF Academy Technical Note, August 1978.

13. Performance Incentives and Planning Under Uncertainty

Principal Investigator: Major Gregory G. Hildebrandt, Department of Economics, Geography and Management

The presentation discussed the use of the performance incentive function (PIF) by planning organizations when there is subjective or objective uncertainty. It is proven that a PIF can be constructed which

achieves both allocational and distributional optimality, when there is subjective uncertainty about the conditions of production and both the center and the producer are risk averse. When there is objective uncertainty, however, it is shown that it is not, in general, possible for the center to achieve these two objectives simultaneously.

Presentation

Colorado University, October 1977.

14. Optimal Subsidy Functions

Principal Investigator: Major Gregory G. Hildebrandt, Department of Economics, Geography and Management

The report discusses the specific problem of controlling a monopoly when market demand is used as the basis for measuring benefits. The control tool used to achieve the regulators objectives is called an "optimal subsidy function." It is shown that while such an optimal function always exists for the one good case, when more than one good is involved existence requires equality of the market cross derivatives of demand with respect to price.

Publication

USAFA-TR-77-17, USAF Academy Technical Report, November 1977.

Presentation

Colorado University, October 1977.

15. Strategic Stockpiling and Substitution

Principal Investigator: Major Gregory G. Hildebrandt, Department of Economics, Geography and Management

17

Associate Investigator: 2Lt John P. Bloom, Jr.

This report analyzes the strategic stockpiling methodology used by the Federal Preparedness Agency. A number of limitations of the existing approach are discussed. For example, the basic planning approach does not consider the likelihood of an emergency. This omission is justified only if substitution is not possible. Yet, there is evidence that the economy is capable of a flexible response to an emergency. Thus, an approach is suggested which explicitly accounts for the likelihood of an emergency.

Currently, the demand for strategic materials is estimated using a model of a peacetime market economy with only a limited allowance made for substitution in production. The estimates of the supply of strategic materials may also be inadequate as the current procedure ignores the use of a price mechanism to activate increases in supply.

A major conclusion is that the variegated nature of strategic materials seems to imply that a more detailed analysis of each material's demand and supply characteristics be accomplished before a stockpile decision is made.

Publication

USAFA-TR-78-3, USAF Academy Technical Report, January 1978.

16. Technical Communication in Research and Development: A Longitudinal Analysis

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Presentation

TIMS XXIII International Meeting, Athens, Greece, July 1977.

17. A Model for MBO in the Air Force

Principal Investigator: Lt Colonel Robert L. Taylor, Department of Economics, Geography and Management

Associate Investigator: 2Lt Eskridge, Department of Economics, Geography and Management

Presented in this paper is a philosophy of MBO which has received widespread acceptance in the Air Force. The steps of the MBO process--goal setting, action planning, self-control, and periodic review are all discussed with the goal of establishing a viable MBO program. Some of the potential pitfalls of implementing MBO are also discussed, along with suggested methods of coping with the problems. The paper concludes with a summary of specific advantages of a good MBO program. An annotated bibliography is included to serve as a guide to current MBO literature.

Publication

USAFA-TR-78-1, USAF Academy Technical Report, January 1978.

B. Department of Mathematical Sciences

1. Aircraft Modification Study

Principal Investigators: Major Charles R. Mitchell and Major William J. Riley, Department of Mathematical Sciences

Sponsored by the Air Force Acquisitions Logistics Division

The purpose of this study was to model the change in performance resulting from an aircraft modification designed for reliability improvement (RI). The potential value to the AF of a reliability improvement warranty, which is a new procurement strategy for weapon systems, depends to a great degree on the contractor's ability to estimate which equipment modifications will produce improved reliability. The state-of-the-art on predicting reliability growth and modification cost is largely unsupported by any data and therefore the AF is very skeptical of contractor proposals for RI. Surprisingly, no program exists to systematically verify the need for or the effect of an RI equipment modification.

This research began in November 1976 and a final report was given to AFALD in February 1978. The report was entitled "Aircraft Reliability Improvement Modifications: Tracking and Analysis of Effects." The primary product was a computerized system which uses two existing AF data systems to track each aircraft's performance in equal periods of time on either side of a modification event. Also, statistical analyses were developed to determine any RI resulting from a modification. The PRAM (Productivity, Reliability, Availability, and Maintainability) office at ASD has been very interested in this research. In fact, they cancelled a proposed similar project with the Boeing Co. after learning of this study. Also, the AF Logistics Management Center is presently using these results to assess the effects of a new aircraft maintenance concept called reliability centered maintenance.

2. Statistical Analysis of Demand and Leadtime Data for the Air Force Standard Base Supply System

Principal Investigators: Major Charles R. Mitchell and Major Robert A. Rappold, Department of Mathematical Sciences

Sponsored by the Air Force Logistics Management Center

One of the key elements in a supply system is a forecast of demands during the stock replenishment time (often called leadtime). An accurate forecast means that a re-order for stock replenishment can be timed so that the stock balance is zero when the new stock arrives. An inaccurate forecast can cause a stock-out condition if the forecast is too low; this in turn can result in a non-operational ready status for aircraft or other systems.

Several theoretical probability models exist to describe demands during leadtime. In this study both demand and leadtime are assumed to be random variables; actual data from an AF supply account are being studied to empirically determine their distributions. Only non-repairable type items are being considered. The findings will be used by the AFLMC in a DoD directed study concerning uniform time inventory policies for all of the services.